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NOTULAE MALACOLOGICAE, XXXVI

# ON SOME HYGROMIIDAE (GASTROPODA: HELICOIDEA) LIVING IN SARDINIA AND IN CORSICA. (STUDIES ON THE SARDINIAN AND CORSICAN MALACOFAUNA VI)*

## INTRODUCTION

In a recent publication on terrestrial and fresh water molluscs in Sardinia, GIUSTI & CASTAGNOLO (1983) listed many well known Helicidae (sensu Auctorum) and two uncertain taxa, apparently belonging to the subfamily Hygromiinae (sensu Auctorum), which they gave the indication «*N. gen. n. sp.*». A more precise definition of the two species was not possible because of a number of unresolved taxonomic problems regarding apparently related species living in Corsica, usually included in the genus *Cyrnotheba* GERMAIN, 1929. Investigation of these problems now enables the present revision and the identification of the new taxa which will be described. Some more species belonging to other genera of the Hygromiinae (sensu Auctorum) and to *Monacha* will also be discussed. Their study was the necessary pre-requisite to the solution of other taxonomical and nomenclaturistic problems.

The present study was made extremely difficult by the absence of the original materials of some of the taxa described by MABILLE (1880) and CAZIOT (1902). This often forced us to rely upon the opinions of previous authors, particularly GERMAIN (1929, 1930), who apparently resolved many of the systematical problems current for the Corsican species which we shall discuss here.

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# SYSTEMATIC REVIEW

## Genus *Monacha* Fitzinger, 1833

Type species: *Helix cartusiana* Müller, 1774; subsequent designation: Gray (1847).

### *Monacha* (s. str.) *cartusiana* (Müller)

(Fig. 1; Pl. 1: Figs. A-D; Pl. 8: Figs. A-B; Pl. 12: Figs. A-D, G)

*Helix cartusiana* Müller, 1774. Verm. terr. fluv., **2:** 15. Locus typicus: France.
*Helix carthusianella* Draparnaud, 1801. Tabl. Moll. France: 86.
? *Helix carthusiana* (sic!), Villa, 1836. Conchiglie ed Insetti raccolti nell'Isola di Sardegna. Milano, (handbill!).
*Helix carthusianella*, Villa, 1836. Conchiglie ed Insetti raccolti nell'Isola di Sardegna. Milano, (handbill!).
*Helix carthusianella*, Shuttleworth, 1843. *Mitt. naturf. Ges. Bern*, **2:** 15.
*Helix Carthusianella*, Requien, 1848. Cat. Coquilles Corse: 45.
*Helix (Zenobia) carthusiana* (sic!), Moquin Tandon, 1855. Hist. nat. Moll. terr. fluv. France, **2:** 207-209, **3:** Pl. 16, Figs. 20-26.
*Helix carthusiana* (sic!), Adami, 1876. *Bull. Soc. malac. it.*, **2:** 219.
*Helix (Carthusiana) carthusiana* (sic!), Paulucci, 1882. *Bull. Soc. malac. it.*, **8:** 202-203.
*Helix (Theba) Guittoni* Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 106-107, Pl. 1: Figs. 1-1a-1b. (fide Germain, 1929).
*Helix (Theba) Carthusiana* (sic!), Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 108.
*Helix (Theba) Stagnina*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 108.
*Helix (Theba) Sarriensis*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 109.
*Helix (Theba) Ventiensis*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 109.
*Helix (Theba) Episema*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 109.
*Helix (Theba) Rufilabris*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 110.
*Helix stagnina*, Caziot, 1903. *Mem. Soc. zool. France*, **16:** 33.
*Theba* (s. str.) *carthusiana* (sic!), Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 277-280, Pl. 11: Figs. 371, 373-374, 376-383, Pl. 12: Figs. 384-385, 387, 390-392, 394, 397-399, 404-405.
*Theba* (s. str.) *carthusiana* (sic!) var. *rufilabris,* Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 280-282, Pl. 12: Figs. 386, 388-389, 393, 395-396, 410, 412, 415, 417, 420, 422, Pl. 13: Figs. 425, 430, 435, 439-442, 445-447, 450-452.
*Theba* (s. str.) *carthusiana* (sic!), Germain, 1930. Faune France, **21:** 266-267, Fig. 205, Pl. 2: Figs. 40-41.
*Theba* (s. str.) *carthusiana* (sic!) var. *rufilabris,* Germain, 1930. Faune France, **21:** 267.
*Theba* (s. str.) *carthusiana* (sic!), Alzona, 1971. *Atti Soc. it. Sci. nat. Mus. civ. St. nat. Milano,* **111:** 180.
*Theba* (s. str.) *carthusiana* (sic!) *rufilabris,* Alzona, 1971. *Atti Soc. it. Sci. nat. Mus. civ. St. nat. Milano,* **111:** 180.
*Monacha* (s. str.) *cartusiana*, Giusti & Castagnolo, 1983. *Lav. Soc. it. Biogeogr.*, (NS), **8:** 235.
*Monacha cartusiana*, Holyoak, 1983. *J. Conch. London*, **31:** 246.

## Material examined (1):

**Corsica:** 1) Aleria, 30.11.1983 (n); 2) Bastia, bords de la grand route en peau apres Toga, Hagenmuller leg. (1), MHNM; 3) Bravone, 30.11.1983 (1); 4) near Castifao, loc. Ponte Volparone, Bodon leg. 31.3.1984 (4); 5) Corse, (1), Sollier Coll., MHNM; 6) near Corte, Pinter leg. 11.8.1977 (4); 7) Francardo, 21.4.1980, 1.12.1983 (n); 8) near Moltifao, outside Pietrobello Cave, Taiti & Campanili leg. 10.10.1982 (1); 9) near Pietralba, 9.4.1970 (1); 10) Ponte Leccia, Pinter leg. 13.8.1977 (n); 11) St. Florent, 1980 (2); Bodon leg. 31.3.1984 (2); 12) between St. Pierre de Venaco and Corte, 2.12.1983 (3); 13) environs de St. Pierre de Venaco, Hagenmuller leg. (4) (8) det. *H. episema*, MHNM.

**Sardinia:** 1) Arbatax, Nienhuis leg. 12.1.1972 (2); 2) Decimomannu, 30.4.1974 (3); 3) near Cantoniera Rosario, loc. Monte delle Case, Gandin leg. 6.1981 (5); 4) near Fluminimaggiore, outside of Su Mannau Cave, 22.10.1974 (2); 5) near Laconi, 24.4.1985 (1); 6) Monte Zirra, Gandin leg. 6.1981 (1); 7) between Nurallao and Isili, Pinter leg. 30.6.1981 (2); 8) Nuxis, slopes of Monte Nieddu, 23.3.1976 (1); 9) near Olbia, 22.10.1974 (6); 10) Nuraghe of Sant'Antine (2).

## Historical Notes

The names *Helix cartusiana* Müller (or *H. carthusiana*, sic!) and *Helix carthusianella* Draparnaud appear frequently in the catalogues of Sardinian (Villa 1836; Adami, 1876; Paulucci, 1882; Alzona, 1971; Giusti & Castagnolo, 1983) and Corsican faunas (Payraudeau, 1827; Shuttleworth, 1843; Requien, 1848; Moquin-Tandon, 1855; Caziot, 1902; Germain, 1929, 1930; Alzona, 1971; Holyoak, 1983). However, some of these authors use *H. cartusiana* sensu Draparnaud as a synonym for *Helix cantiana* Montagu (see Moquin-Tandon, 1855). Caziot (1902, 1903) distinguishes the different phenotypes as separate species, using names which were then known in literature (see list of synonyms: 124) and creating a new name: *Helix guittoni* which Germain (1929, 1930) considered to be a certain synonym for the species of Müller.

## Description and Comments

The shell shape of the specimens collected in Sardinia and Corsica (Pl.l: Figs. A-D) corresponds with those of populations from the Italian mainland and other European countries. Though slightly smaller in the mean, the dimensions (h = 5-8.5 mm, max. diam. = 8.6-15 mm) also correspond to those of European specimens (Kerney et al., 1983). The colour of the shell is also usually typical but there are populations having a fragile shell, with elevated spire of a darker colour, from golden-yellow to dark brown. The microsculpture of the external shell surface (Pl. 8: Figs. A-B) has the following characteristics: the surface of the protoconch is smooth or slightly grooved by thin spiral striae; there are no sign of hairs or hair impressions; the periostracal surface of the teleoconch is roughened by a system of fine spiral crests, disposed in an irregular pattern often with discontinuities and fragmentation. There are large areas of smooth surface. The material which constitutes the crests is thus probably caducous and easily removed.

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(1) The names of the Museums have been reduced as follows:
MHNM = Museum d'Histoire Naturelle de Marseille (France)
MNHNP = Museum National d'Histoire Naturelle de Paris (France)
MZUF = Museo di Zoologia dell'Università di Firenze (Italy)
NMB = Naturhistorisches Museum Bern (Switzerland)
NMW = Naturhistorisches Museum Wien (Austria)
SMF = Senckenberg Museum Frankfurt (West Germany)

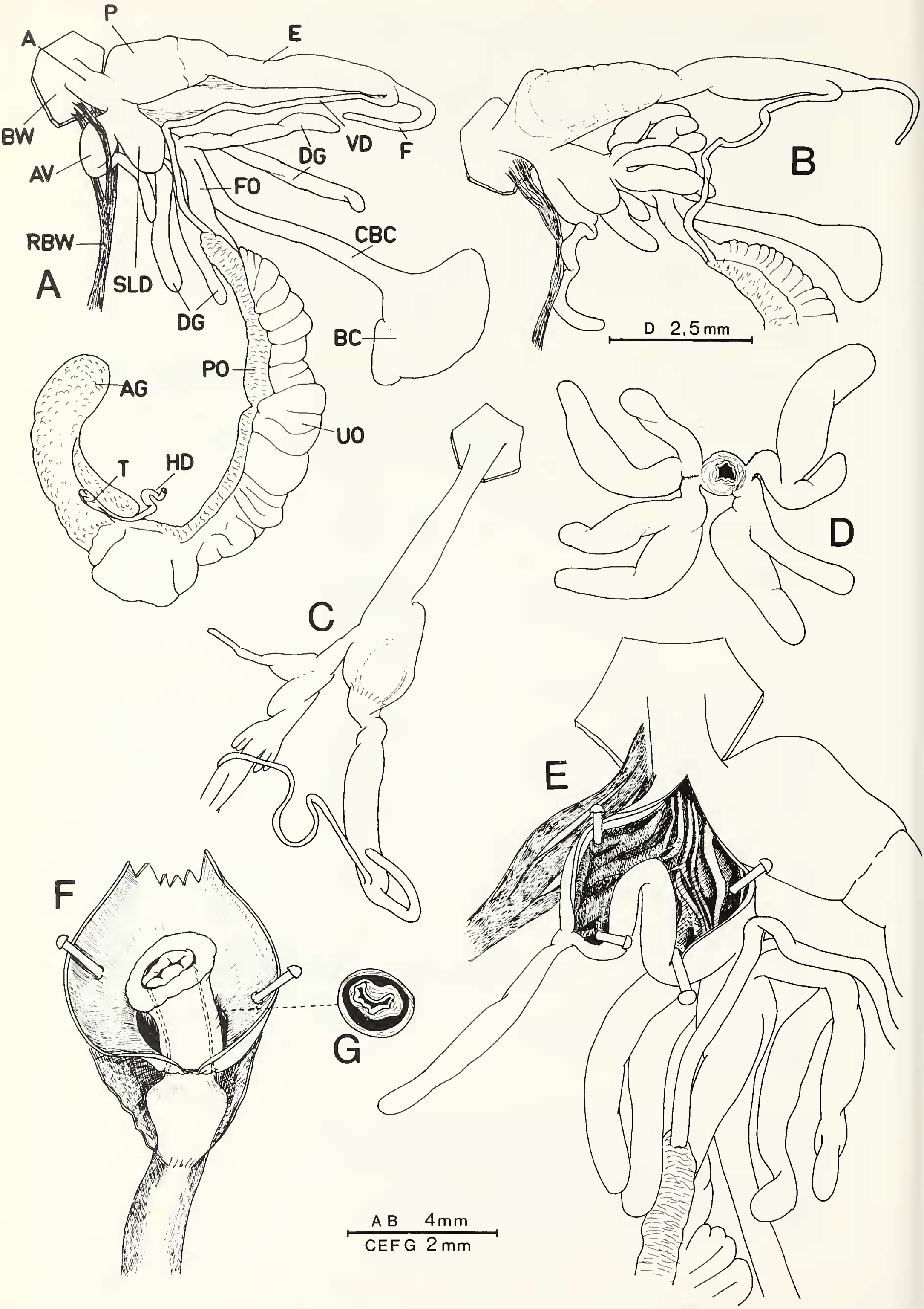
P
A
E
BW
AV
VD
F
DG
FO
RBW
CBC
SLD
A
DG
BC
PO
AG
UO
T
HD
B
D 2,5 mm
C
D
E
F
G
AB 4mm
CEFG 2mm

Fig. 1

The genital apparatus (Fig. 1) has not a single feature that could distinguish the Sardinian and Corsican populations from those of the Italian mainland and Europe in general. Here we wish to point out that a constant feature of the genital tract of both juvenile and sexually adult specimens of *M. cartusiana* has often been omitted from the anatomical drawings published in literature (MOQUIN-TANDON, 1855; DAMIANOV & LIKHAREV, 1975; SCHILEYKO, 1978; GROSSU, 1983) (2) or when illustrated and described, its importance has not been recognised (STURANY & WAGNER, 1914; GERMAIN, 1930; GITTENBERGER et al., 1970, 1984; VARGA, 1972; PRIETO, 1980; GIUSTI & CASTAGNOLO, 1982; LUPU, 1982; MANGA GONZALES, 1983). We refer to a short sac-like diverticulum situated at the base of the appendicula vaginalis between the latter and the digitiform glands. The diverticulum shows an internal system of folds continuing on the vaginal wall, alongside those which terminate in the widened base of the appendicula vaginalis. Only TAYLOR (1917) illustrated and described this structure considering it as a «degenerated dart-sac». The purpose of this sac-like diverticulum is not clear. It has the appearance of a vestigial stylophore (i.e. dart sac), in which case *M. cartusiana* conserves the remains of two stylophores (appendicula vaginalis and sac-like diverticulum) located one immediately adjacent to the other, on the same side of the vagina.

According to SCHILEYKO's scheme (1978b: 63, Fig. 33) illustrating the modifications undergone by the vaginal structures in the course of the evolution of the Hygromiidae (sensu SCHILEYKO, 1978b), *M. cartusiana* could belong to the Hygromiinae and not as SCHILEYKO suggests in 1978 to the Euomphaliinae (3). *Monacha* could even be given status independent of

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2) SCHILEYKO (1978b: 287, Fig. 376) illustrates the vagina and the base of the appendicula vaginalis of *M. cartusiana* but shows no diverticulum. This is unlikely to be an error so it may be supposed that the specimen belonged not to *M. cartusiana* but to another species (perhaps related to *M. dissimulans* PINTER and/or to *M. carascaloides* BOURGUIGNAT, see DAMIANOV & LIKHAREV, 1975).

3) As shown by Schileyko (1978b) Monachinae ZILCH, 1960 is a junior homonym of Monachinae GRAY, 1869 (as Monachina) for the genus *Monachus* Fleming (Mammalia: Focidae) and must therefore be substituted. This problem was automatically resolved by inserting *Monacha* in the subfamily Euomphaliinae.

**Fig. 1** - *Monacha* (s. str.) *cartusiana* (MÜLLER). The genital duct and its portions in specimens collected near Bravone (Corsica) (A, E); Olbia (Sardinia) (B, D, F-G) and Pian del Lago (SI, Italy). A-B: the genital duct (gonad excluded). Note the wide sac-like diverticulum (SLD) of the vagina. C: the distal portion of the genital duct in a young specimen, the SLD is clearly visible; D: digitiform glands of the specimen in B; E: the base of the appendicula vaginalis and the SLD are opened to show their inner structure; F: the penis distal portion is opened to show the penial papilla; G: the transverse section of the penial papilla half way along its lenght.
**A** atrium, **AG** albumen gland, **AV** appendicula vaginalis, **BC** bursa copulatrix (= gametolytic gland), **BW** body wall, **CBC** duct of the bursa copulatrix, **DG** digitiform glands, **DS** dart sacs (= stylophores), **E** epiphallus, **ESO** external sac opening, **F** flagellum, **FO** free oviduct, **HD** hermaphroditic duct, **ISO** inner sac opening, **OC** organ of contact?, **P** penis, **PO** prostatic portion of the ovispermiduct, **PP** penial papilla, **PR** penial retractor, **PV** proximal vagina, **RBW** retractor of the body wall, **SLD** sac-like diverticulum, **T** talon, **UO** uterine portion of the ovispermiduct, **V** vagina, **VC** vaginal cone, **VCO** vaginal cone opening, **VD** vas deferens, **VO** vaginal opening.

the Hygromiinae and the Euomphaliinae, and form a separate subfamily. Unfortunately it is not easy to find additional support for such an hypothesis. The collocation of the right ommatophore retractor (r.o. retractor), for example, is not considered to be important as in the past (Schileyo, 1972b) and cannot be used as a subfamily diagnostic character. According to Schileyko (1978b), species with r.o. retractor between penis and vagina or independent r.o. retractor coexist both in the Hygromiinae and in the Euomphaliinae. Only the penial papilla which is similar in *Monacha* to that in *Euomphalia*, seems to support Schileyko's opinion. The value of this character is, however, still uncertain (Pinter, 1977).

If the sac-like diverticulum is not a vestigial stylophore but a newly formed structure or part of the same single stylophore which became the appendicula vaginalis, then the inclusion of *Monacha* in the Euomphaliinae, as proposed by Schileyko (1978b) is valid. Wether we consider the sac-like diverticulum a second vestigial stylophore or not, *M. cartusiana* is differentiated from many other species of the same genus and particularly from the others included in the subgenus *Monacha* (s. str.). The latter do not have a sac-like diverticulum, but an appendicula vaginalis with a different base (see: Fig. 3A, C) and generally a short wide truncated conical glans (not long and cylindrical as in *M. cartusiana*) (see: Fig. 3D-E). It is therefore possible that while *M. cartusiana* remains alone in the typical subgenus, the other species must be included in a new separate subgenus. We shall refrain from proposing a new taxon for the present, as anatomical data on many species are completely lacking or not at all clear. Moreover some species well known in literature seem to be similar to *M. cartusiana*, to judge from the structure of the appendicula vaginalis and glans, but because of the absence of the sac-like diverticulum seem to stand more closely to *M. cantiana* and to other related species (see Pinter, 1968: 222, Figs. 5-8; Damianov & Likharev, 1975: 365, Fig. 294).

The radula of a specimen collected in Corsica (St. Florent) (Pl. 12: Figs. A-D) was found to consist of many rows of teeth, each having a central tooth and 37-41 teeth on each side, according to the formula 37-41+C+37-41. The central tooth has a robust basal plate with two upper pointed vertices. The tooth is divided at its apex into a long robust pointed mesocone and two short ectocones. The first lateral teeth also have a strong basal plate but with only a single upper pointed vertex (outermost). The apex of the lateral teeth has the form of a robust pointed mesocone and a short wide ectocone. On its inner side, the mesocone sometimes has a notch or slight protuberance near the apex. This is probably a sign of the second point which appears at the apex of the mesocone of the last lateral teeth and the marginal teeth. Moving laterally, the teeth become gradually less robust with more slender and pointed cusps and smaller basal plate. From 27th tooth and beyond, some teeth also begin to have a double ectocone with two similar points.

## Zoogeographical Notes

The species has an ample distribution in Europe, particularly in the west, and is found in heavily anthropized and cultivated areas. The likehood of its easy distribution by man makes this species unsuitable for zoogeographical analysis (Giusti & Castagnolo, 1983).

### *Monacha* (s. str.?) *cantiana* (Montagu)

(Figs. 2-3; Pl. 1: Figs. E-G; Pl. 2: Figs. A-H; Pl. 7: Figs. A-E; Pl. 13: Figs. A-C)

*Helix cantiana* Montagu, 1803. Test. Brit.: 422, Pl. 23: Fig. 1. Locus typicus: Britannia major = England.

*Helix carthusiana* (sic!), Draparnaud, 1801. Tabl. Moll. France: 86 (non Müller, 1774).

*Helix carthusiana* (sic!), Payraudeau, 1827. Cat. Ann. Moll. Corse: 100 (non Müller, 1774).

*Helix carthusiana* (sic!), Shuttleworth, 1843. *Mitt. naturf. Ges. Bern*, **2:** 15 (non Müller, 1774).

*Helix Carthusiana* (sic!), Requien, 1848. Cat. Coquilles Corse: 45 (non Müller, 1774).

*Helix perlevis* Shuttleworth, 1852. *Mitt. naturf. Ges. Bern*, **260-261:** 215 (partim).
Locus typicus: «Tam in Corsica quam in Sardinia».
Locus typicus restrictus: Aleria in Corsica (present paper).

*Helix perlevis*, Pfeiffer, 1853. Mon. Hel. viv., **3:** 637-638 (partim).

*Helix (Zenobia) cantiana*, Moquin-Tandon, 1855. Hist. nat. Moll. terr. fluv. France, **2:** 201-204, **3:** Pl. 16: Figs. 9-13.

*Helix (Fruticicola) perlevis*, Albers, 1860. Heliceen Verwandt.: 104 (partim).

*Helix (Fruticicola, Zenobia) perlevis*, Kobelt, 1871. Cat. Binn.: 10 (partim).

*Helix Ousterea* Mabille, 1880. Guide Nat., **2** (3): 62-63 (fide Hesse, 1921 and Germain, 1929).

*Helix Monerebia* Mabille, 1880. Guide Nat., **2** (3): 63 (fide Hesse, 1921 and Germain, 1929).

*Helix Gaudefroyi* Mabille, 1880. Guide Nat., **2** (3): 63 (fide Hesse, 1921 and Germain, 1929).

*Helix Delacouri* Mabille, 1880. Guide Nat., **2** (3): 63-64 (fide Hesse, 1921 and Germain, 1929).

*Helix Ischnia* Mabille, 1880. Guide Nat., **2** (3): 64 (fide Hesse, 1921 and Germain, 1929)

*Helix Abebaia* Mabille, 1880. Guide Nat., **2** (3): 64 (fide Hesse, 1921 and Germain, 1929).

*Helix Euclastolena* Mabille, 1880. Guide Nat., **2** (3): 64 (fide Hesse, 1921 and Germain, 1929).

*Helix (Arichia)* (sic!) *perlevis*, Paulucci, 1882. *Bull. Soc. malac. it.*, **8:** 202 (partim).

*Helix (Helicella, Fruticicola, Trichia) perlevis*, Tryon, 1887. Manual Conch. Pulmonata, (II) **3:** 181-182 (partim).

*Helix (Fruticicola, Trichia) perlevis*, Westerlund, 1889. Fauna paläarct. Reg. Binn., **2:** 64 (partim).

*Helix (Fruticicola, Trichia) ischnia*, Westerlund, 1889. Fauna paläarct. Reg. Binn., **2:** 65.

*Helix (Fruticicola, Trichia) euclastolena*, Westerlund, 1889. Fauna paläarct. Reg. Binn., **2:** 65.

*Helix (Fruticicola, Theba) cantiana*, Westerlund, 1889. Fauna paläarct. Reg. Binn., **2:** 78.

*Helix (Fruticicola, Theba) cemenelea*, Westerlund, 1889. Fauna paläarct. Reg. Binn., **2:** 79-81 (with? *delaeuri* (sic!), *ousterea*, *gaudefroyi* and *abebaia* as varietates).

*Helix (Trichia) perlevis*, Kobelt, 1890. Icon. Land-Suss.-Moll., (N F), **5:** 5 (partim).

*Hygromia (Fruticicola) perlevis*, Pilsbry, 1895. Manual Conch. Pulmonata, (II) **9:** 274 (partim).

*Helix (Zenobia) Corsica*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 93-94 (non Shuttleworth, 1843).

*Helix (Zenobia) Perlevis*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 95-96 (partim).

*Helix (Theba) Cemenelea*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 96.

*Helix (Theba) D'Anconae*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 96-97.

*Helix (Theba) Delacouri*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 97-98 (fide Germain, 1929).

*Helix (Theba) Ischnia*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 98-99 (fide Germain, 1929).

*Helix (Theba) Abebaia*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 99-100 (fide Germain, 1929).

*Helix (Theba) Ousterea*, Caziot 1902. *Bull. Soc. Sci. hist. nat. Corse:* 100 (fide Germain, 1929).

*Helix (Theba) Monerebia*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 100-101 (fide Germain, 1929).

*Helix (Theba) Gaudefroyi*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 101-102 (fide Germain, 1929).

*Helix (Theba) Euclastolena*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 102-103 (fide Germain, 1929).

*Helix (Theba) Thomasinae*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse:* 103-104, Pl. 1: Figs. 3-3a-3b (fide Hesse, 1921 and Germain, 1929).

*Theba* (s. str.) *cantiana*, Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 270-272, Pl. 10: Figs. 292-293, Pl. 11. Figs. 351-352.

*Theba* (s. str.) *cemenelea*, Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 272-276, Pl. 10: Figs. 329-330, Pl. 11: Fig. 342 (partim).

*Theba* (s. str.) *cemenelea* var. *d'Anconae*, Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 276-277, Pl. 10: Figs. 309, 316, 323-325, 332.

*Theba (Cyrnotheba) corsica*, Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 282-283 (partim, non Shuttleworth, 1843).

*Theba (Cyrnotheba) perlevis*, Germain, 1929. *Arch. Mus. Hist. nat. Lyon,* **13:** 283-284 (partim).

*Theba* (s. str.) *cantiana*, Germain, 1920. Faune France, **21:** 263-265, Fig. 204, Pl. 3: Fig. 62.

*Theba* (s. str.) *cemenelea*, Germain, 1930. Faune France, **21:** 265-266, Fig. 206, Pl. 5: Figs. 127-134 (partim).

*Theba* (s. str.) *cemenelea* var. *d'Anconae*, Germain, 1930. Faune France, **21:** 266.

*Theba (Cyrnotheba) corsica*, Germain, 1929. Faune France, **21:** 268 (partim, non Shuttleworth, 1843).

*Theba (Cyrnotheba) perlevis*, Germain, 1929. Faune France, **21:** 268-269 (partim).

*Monacha (Cyrnotheba) corsica*, Zilch, 1960. Hand. Palaozool., **6** (2, 4th part): Fig. 2357 (non Shuttleworth, 1843).

*Theba* (s. str.) *cantiana cemenelea*, Alzona, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 181.

*Theba* (s. str.) *cantiana danconae*, Alzona, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 181.

*Theba (Cyrnotheba) corsica*, Alzona, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 184 (partim, non Shuttleworth, 1843).

*Theba (Cyrnotheba) perlevis*, Alzona, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 184 (partim).

*Monacha cantiana*, Holyoak, 1983. *J. Conch. London*, **31:** 246 (partim).

*Monacha corsica*, Holyoak, 1983. *J. Conch. London*, **31:** 184 (partim, non Shuttleworth, 1843).

*Monacha perlevis*, Holyoak, 1983. *J. Conch. London*, **31:** 246-247 (partim).

## Material examined:

**Corsica:** 1) Aleria, Blauner leg., Lectotypus + 2 Paralectotypi of *H. perlevis* Shuttleworth. Shuttleworth Coll., NMB 715; 2) Bastia, (1), Caziot det. *H. bastitensis*. Ex Caziot Coll., SMF 69130; 3) Bastia, (2), Zilch (1960: Fig. 2357) det. *M. (C.) corsica*. Ex Boettger Coll., 1910, SMF 98768; 4) Bastia, (2) det. *Z. corsica*. Ex Klemm Coll., NMW 30251; 5) Bastia, route de St. Florent, a 500 m de la ville, Hagenmuller leg. 1885, (1) det. *H. ousterea*, MHNM; 6) Bastia, 19-20.4.1980, 29.11.1983, (n); Pinter leg. 10.10.1977, (8); 7) Bonifacio, coteaux a 4 kil., a droite de la route en allant a Sartene, un peau avant d'arriver au chemin de l'Ermitage de la Trinité, Hagenmuller leg. 1885, (6) Bourguignat det. *H. bonifaciensis* Hagenmuller (*H. bonifaciensis* Hagenmuller, non Caziot (1902) is a *nomen in schedula*); (6), Bourguignat det. *H. marianumensis* Hagenmuller (*H. marianumensis* Hagenmuller is a *nomen in schedula*), MHNM; 8) Bonifacio, (8), MHNM; 9) Bonifacio, (10) det. *H. corsica*, MHNM; 10) Bonifacio, (1) det. *M. (C.) corsica*. Ex Moellendorff Coll., 30.6.1913, SMF 69118; 11) Bonifacio, ancien chemin de Sartene, Hagenmuller leg. 1885, (11) det. *H. delacouri*. MHNM; 12) Bonifacio, (3) det. *H. subanconae (H. subanconae* is a *nomen in schedula)*; 13) Bonifacio, 22.4.1980, 1.12.1983 (n); 14) near Bonifacio, loc. Foce di Lera, Pinter leg. 9.8.1977 (n); 15) near Bonifacio, loc. St. Jean, Bodon leg. 27.3.1984 (1); 16) Calvi, (1) Caziot det. *H. perlevis*; 17) Cardo, 19.4.1980, (7); Pinter leg. 1977, (1); 18) near Castifao, loc. Ponte Volparone, Bodon leg. 25.3.1984, (2); 19) Col de Teghime, 20.4.1980, (1); 20) Corte, (6) det. *H. delacourti* (sic!); (3) det. *H. delacourti* (sic!). MHNM; 21) Corte, Pinter leg. 27.8.1980, (2); 22) near Défilé de Lancone, Lanza leg. 4.1977, (2); 23) Etang de Biguglia, Holyoak leg. 15.12.1977, (2); 24) Oletta, 20.4.1980, (n); 25) St. Florent, 8.4.1980, (5).

## Historical Notes

*Monacha cantiana* under this and other names was erroneously reported in Sardinia. Villa (1836) and Issel (1873), infact, gave the names of *Helix cantiana* and *Helix Anconae*? respectively to some poorly identified helicids collected in Sardinia. On this basis Paulucci (1882) dubiously listed *H. anconae* among the species found in Sardinia. *M. cantiana* was then consequently reported in Sardinia by Germain (1929, 1930) and Alzona (1971). *M. cantiana* was repeatedly reported in Corsica under various names by Payraudeau (1827); Shuttleworth (1843); Requien (1847); Moquin-Tandon (1855) Caziot (1902); Germain (1929, 1930); Holyoak (1983). According to Hesse (1921) and Germain (1929, 1930) many of the «species» described by Mabille (1880) in Corsica, later taken up by Caziot (1902), are synonyms of *M. cantiana*. For these two authors *Helix thomasinae* Caziot (1902) is also a certain synonym of the species of Montagu. So in the absence of typical material, we have accepted their opinion and listed the latter species among the synonyms.

*Helix perlevis* Shuttleworth (1852) deserves particular attention. This species was clearly described for one of the shells collected by Blauner at Aleria in Corsica, still kept in the Shuttleworth Collection in the Naturhistorisches Museum Bern, (NMB 715). Its characteristics and dimensions (major diam. = 14 mm, minor diam. = 12 mm, h = 11 mm) agree with the original description by Shuttleworth. According to Article 73a (ii) of ICZN (1985), this identifies the specimen as the holotypus of *H. perlevis*. As there are also two other specimens of smaller dimensions but the same characteristics in the same container, we prefer to designate the first specimen lectotypus and the other two paralectotypi according to the Recommendation 75F of ICZN.

The lectotypus and paralectotypi (Pl. 1: Figs. E-F) correspond perfectly with *M. cantiana* specimens from other parts of the island, having a small thin shell often with sparse periostracal hairs. *H. perlevis* Shuttleworth (1852) is thus a junior synonym of *M. cantiana*.

In the Shuttleworth Collection of the NMB there are three more shells collected by Blauner in Sardinia and labelled *H. perlevis* (no. 716). These do not answer the original description and belong to another species which we shall describe later in this paper.

Although they were not used for the description of *H. perlevis*, these shells were erroneously grouped by Shuttleworth with those from Aleria (Corsica), and this explains why he subsequently states *H. perlevis* to be present in both Corsica and Sardinia.

Unware of the true typical material from Aleria, Paulucci (1882) attributed the name *H. perlevis* to some Sardinian specimens with a globular shell sometimes having a slightly angled last whorl (Pl. 5: Fig. B), solely on the basis of Shuttleworth's original description. As already stated this species will be described later as a separate taxon (Paulucci 1882 gave the name *Helix corsica* to specimens of the same species having a flatter shell with angled last whorl. As a consequence, many authors successively working on *H. perlevis*, accepted the determinations of Paulucci (1882) using the figures she published, thus confirming and disseminating the original error (Tryon, 1887; Westerlund, 1889; Kobelt, 1892; Pilsbry, 1895; Caziot, 1902; Germain, 1929, 1930; Alzona, 1971).

## Description and Comments

It can be seen from the number of collection sites that *M. cantiana* is very widespread in Corsica, and seems to prefer localities where the action of man has been felt for a long time and the natural environment transformed by agriculture. The diversity of ecological conditions determined especially by the geological substrate and the vegetation, is probably responsible for the variability in form, structure and size of the shells of the different populations. The shell is generally globular and the spire of variable height (Pl. 1: Figs. E-F, Pl. 2: Figs. A-G). In rare cases the last whorl is slightly angled. The umbilicus is always small, open and partially covered by the reflexed columellar margin of peristome. Adult specimens in our possession range in size as follows: max. diam. = 12-18 mm, h = 9.5-14 mm. Shell colour varies from brownish yellow to greenish yellow. There is often a lighter band disposed in coincidence with or slightly above the periphery of the last whorl. The terminal part of the whorl, just before the peristome, is sometimes reddish-brown in colour. The mineralized part of the shell is rather thin and the periostracal stratum well formed. The latter is quite densely pilose, especially in young specimens (Pl. 2: Fig. H). The hairs are caducous and completely or nearly absent in adult specimens. Light microscope examination clearly reveals the impressions of the hair roots. By scanning electron microscope, the protoconch (Pl. 7: Fig. A) appears quite smooth or with faint spiral striae. The teleoconch (Pl. 7: Figs. B-E) is seen to have a periostracal layer in which the hairs originate. If the hairs are no longer present, the impressions of their roots are clearly visible. The surface of the periostracal layer has alternate zones with fine spiral grooves (corresponding to grooves of the underlying mineralized stratum) and zones which appear to be covered with a caducous material disposed to form fine spiral crests. In the first whorls these are arranged in a parallel and quite regular manner and are frequently interrupted for stretches of varying lenght. In the last whorls on both the upper and lower surfaces, the periostracal crests are closer, often ramified and irregularly disposed.

The genital apparatus of specimens collected in several Corsican sites (Figs. 2-3) agrees with that of specimens collected in various Italian sites. The dimensions of certain parts of the genital apparatus vary considerably from one population to another, and also within a given population, and would thus seem to depend on variations in body size. The appendicula vaginalis, for example, varies in lenght from 10 to 20.3 mm; the penis (from the genital atrium to the base of the penial flagellum) varies from 4.1 to 12.8 mm; the gametolytic gland and its duct vary from 6.5 to 15 mm. The ratio penis: flagellum varies from 0.85 to 2.26 and covers the whole range recorded in Apennine and Elba populations (Giusti, 1976).

The glans (Fig. 3D-E) has the typical truncated conical appearance well-known in literature (Giusti, 1976).

**Fig. 2** - *Monacha* (s. str.) *cantiana* (Montagu). The genital duct (gonad excluded) in specimens collected in Corsica near the Etang de Biguglia (Holyoak leg.) (A); Bonifacio (B-C) and Bastia (D). Note in A the small sac-like diverticulum (SLD) of the appendicula vaginalis basal portion. In young specimens (B) the appendicula vaginalis is not elongated and shows no basal diverticulum (Symbols as in Fig. 1).

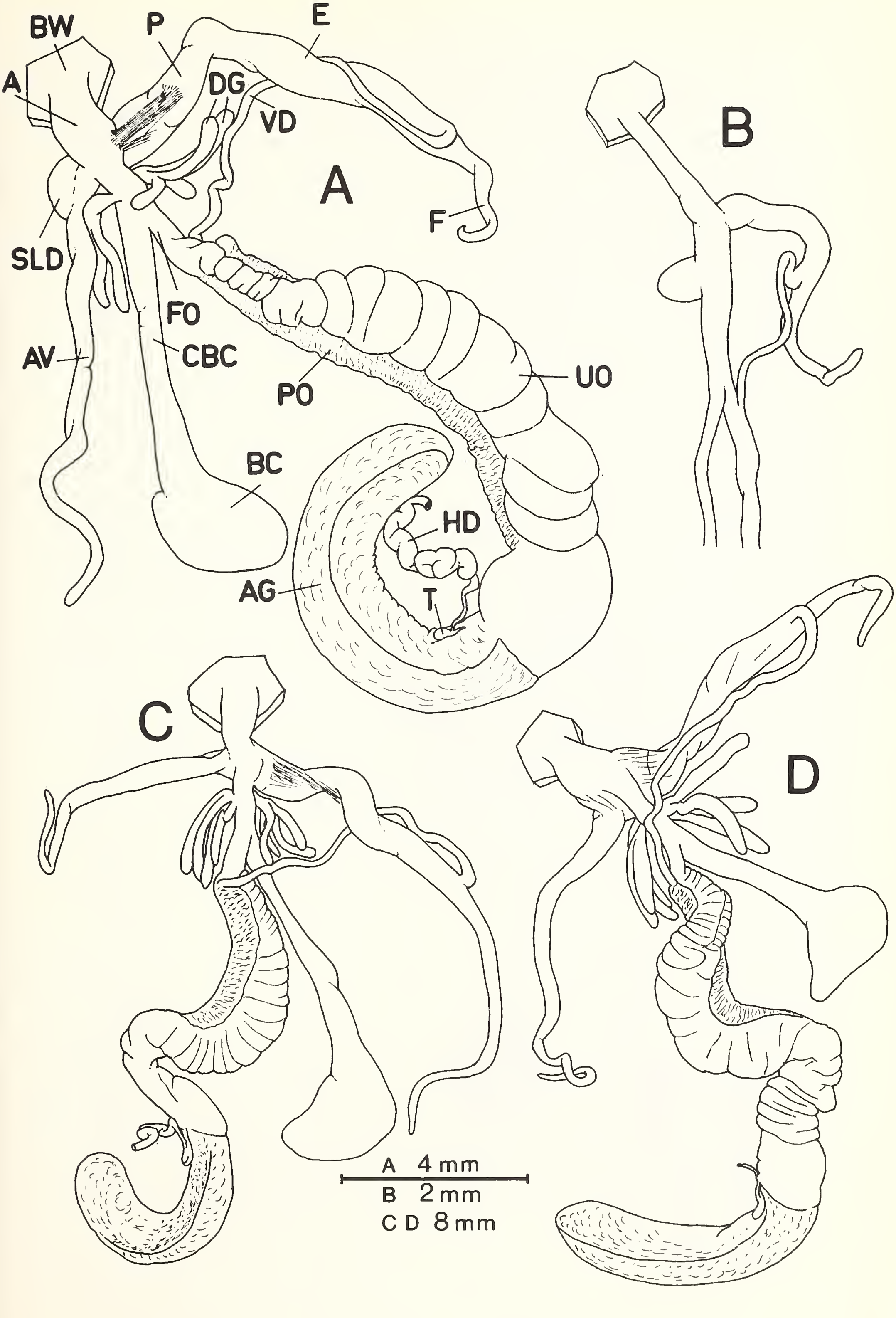


Fig. 2

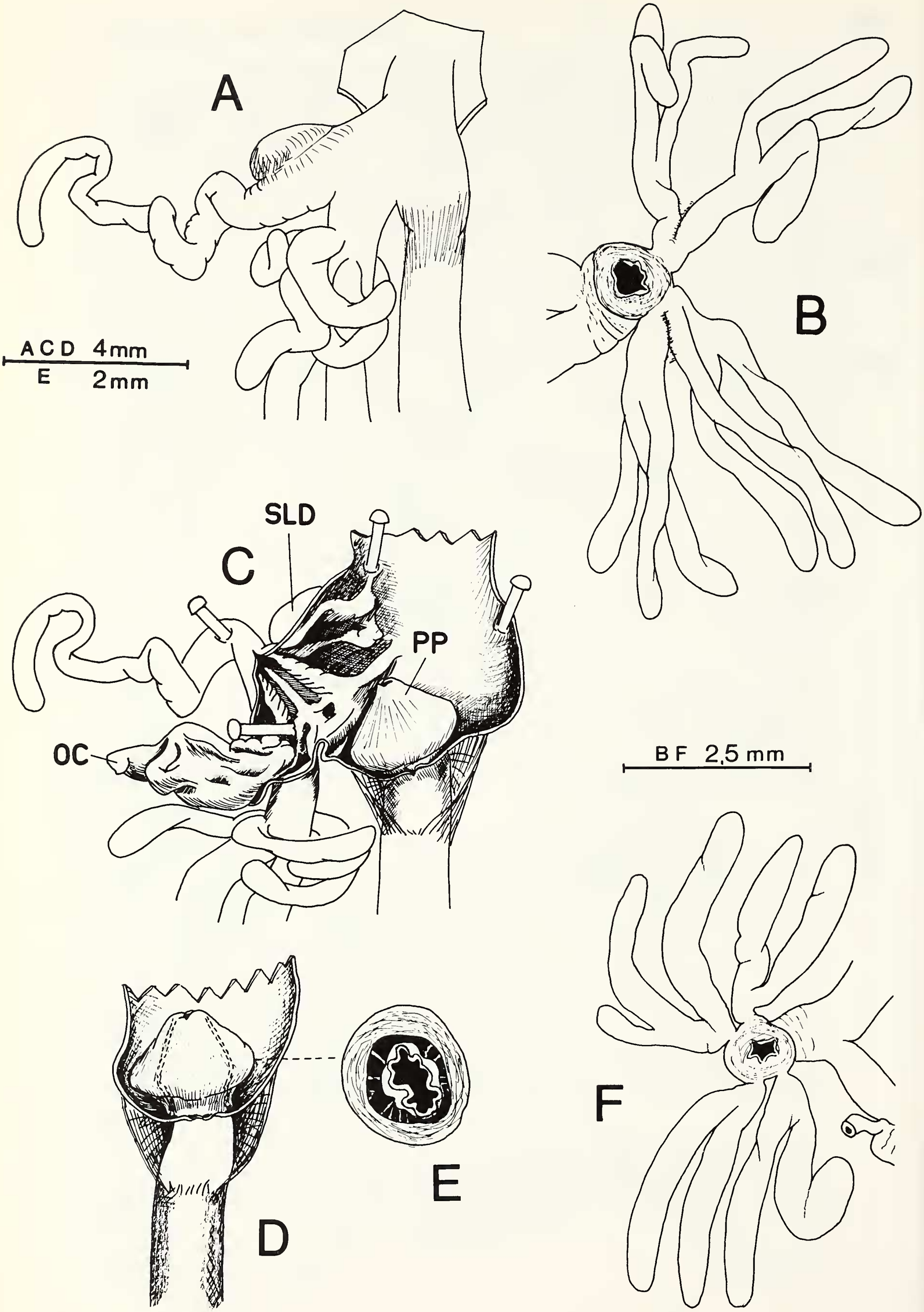


Fig. 3

A hitherto undescribed feature of interest is the presence of an oval evagination on the side of the base of the appendicula vaginalis which faces the genital atrium (Fig. 3 A, C). This structure, which is internally hollow, is not evident in juvenile or not completely sexually mature specimens. Nevertheless it could be considered as a small residue of a vestigial external stylophore. If this was true both *M. cantiana* and *M. cartusiana* show the residues of a second reduced stylophore derived from an internal stylophore in *M. cartusiana* and from an external one in *M. cantiana*. In *M. cartusiana* the sac-like diverticulum is found even in young specimens and thus appears to be a sufficiently distinct element, but in *M. cantiana* the evagination of the basal portion of the appendicula vaginalis is only evident in specimens which have reached full sexual maturity. It therefore seems likely that the evagination is an integral part of the appendicula vaginalis and they are both derived from a single residual stylophore.

Apart our previous considerations when discussing *M. cartusiana*, about the subfamily to which the genus *Monacha* belongs, the evagination we have just described further confirms the anatomical diversity of *M. cartusiana* and *M. cantiana* (and its related species). It follows that it would not be unjustified to place them at least in different subgenera.

The radula (Pl. 13: Figs. A-C) has the typical appearance of the helicids. Each row of teeth is made of a central tooth and 35-36 lateral teeth, according to the formula 35-36+C+35-36. The central tooth has a wide basal plate and prominent pointed upper vertices. The body of the tooth rises from the basal plate surmounted by a wide and long mesocone and two tiny short ectocones. The first lateral teeth also have an evident basal plate but with only one (the external) prominent pointed vertex. The apex of the lateral teeth is constituted by a robust mesocone and by a short sharp ectocone. There is sometimes a slight protuberance on the side of the mesocone facing the central tooth. This may possible be a sign of the second point which appears at the apex of the mesocone of the lateromarginal and marginal teeth. Moving laterally, the teeth become gradually less massive with slender and sharper cusps and smaller basal plate. At about 14th-16th lateral tooth the mesocone begins to curve inwardly and the external side of its apex takes a concave appearance. From 25th-36th tooth the basal plate is no longer visible, the mesocone appears shortened and sometimes shows signs of beginning of a double apex and the endocone now has two or three well defined points.

**Fig. 3** - *Monacha* (s. str.) *cantiana* (MONTAGU). Various portions of the genital duct in specimens from Corsica collected near St. Florent (A, C-E); Foce di Lera near Bonifacio (PINTER leg.) (B) and Bastia (F). A: distal portion of the genital duct showing the sac-like diverticulum (SLD) of the appendicula vaginalis basal portion; B, F: digitiform glands; C: the distal portion of the penis and the vagina. Note that a system of plicae borders the opening of the diverticulum of the appendicula vaginalis basal portion. In this specimen the vaginal wall give rise to an evident tongue-like structure, possibly representing the «organ of contact», i.e. the structure facilitating the right assemblage of the genital pores during the first phases of mating (see GIUSTI & LEPRI 1980); D: the penis distal portion is opened to show the penial papilla; E: transverse section of the penial papilla (Symbols as in Fig. 1).

### Zoogeographical Notes

The same comments as for the above species apply to the presence of *M. cantiana* in Corsica. It is interesting that no specimens have been found in Sardinia. It may be that *M. cantiana* was completly absent from both Sardinia and Corsica and was imported only recently by man into Corsica.

## Genus *Cyrnotheba* GERMAIN, 1929 (page 283, not 422)

Type species: *Helix corsica* SHUTTLEWORTH, 1843, original designation.

*Theba (Cyrnotheba)* GERMAIN, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 282-283. (First description).
*Theba (Cyrnotheba)*, GERMAIN, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 422. (Redescription!).
*Theba (Cyrnotheba)*, GERMAIN, 1930. Faune France, **21:** 267.
*Cyrnotheba*, HESSE, 1931. *Zoologica*, **81:** 32, 42.
*Monacha (Cyrnotheba)*, ZILCH, 1960. Hand. Palaozool., **6** (2, 4th part): 674. (The shell in Fig. 2357 belongs to *M. cantiana*).
*Theba (Cyrnotheba)*, ALZONA, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 183.

### Historical Notes

GERMAIN (1929: 282-283) created the subgenus *Cyrnotheba* (in the genus *Theba* RISSO, 1826, used at that time for the species now listed under *Monacha* FITZINGER, 1833) on the basis of anatomical features which according to MOQUIN-TANDON (1855) characterized the genital apparatus of *Helix corsica* SHUTTLEWORTH which was elected type species.

In the same subgenus, GERMAIN also included *Helix perlevis* SHUTTLEWORTH, a species anatomically unfamiliar to him but which he evidently considered closer to *H. corsica* than to the other related Corsican species: *Theba cemenelea* (= *M. cantiana*).

In the appendix of the same volume (1929: 422) GERMAIN returns to the subject, redefining the subgenus *Cyrnotheba*. This was a mistake for, in taking HESSE's anatomical data (in BÜTTNER, 1926) as more accurate than MOQUIN-TANDON's, he added the presence of an appendicula vaginalis and the absence of a penial retractor muscle to the distinctive characters. These characters do not correspond to those of *H. corsica*, as we shall demostrate below.

On the basis of the same erroneous anatomical characters, HESSE (1931) promotes *Cyrnotheba* to the status of genus and includes therein not only *H. corsica* but also *H. bastitensis* which he considers a good species. ZILCH (1960) reproposes *Cyrnotheba* as a subgenus of *Monacha*.

The above series of events makes it advisable to describe the genus again and define its most significant diagnostic elements:

***Shell Characters*:** medium sized globular or semi-globular shell, spire formed by 5-5$^1/_2$ regularly increasing whorls; last whorl commonly keeled; small umbilicus; elliptical mouth with faintly reflexed peristomal margin; external surface of the protoconch with spiral rows of small tubercles; external surface of the teleoconch with thick periostracal layer having transverse rows of nail-like scales and a dense series of small longitudinal crests.

***Anatomical Characters*:** right ommatophore retractor muscle (r.o. retractor) disposed between penis and vagina; digitiform glands absent; stylophores or appendicula vaginalis absent; penial retractor muscles present; penis as long as epiphallus; penial flagellum sometimes short, sometimes very long; penial papilla (= glans) cylindrical with wrinkled walls and subterminal opening. In transverse section the penial papilla is seen to be formed by an external sheath enveloping an empty cavity in the centre of which there is a canal with wrinkled walls.

## Comments

In anatomical and shell features the genus *Cyrnotheba* has notable similarities to some other genera of the subfamily Hygromiinae (sensu Schileyko, 1972b, 1978b). In shell structure and external microsculpture of the periostracum, the type species *C. corsica* is similar to the species of the genus *Hygromia* (Pl. 8: Figs C-F), *Lozekia* (cfr. Varga, 1978: Figs. 27-41) and certain *Monachoides* (*M. incarnata*, see Kerney & Cameron, 1979: 186). *Hygromia*, *Lozekia* and *Monachoides* are characterised however by the presence of stylophores and digitiform glands in the female part of the genital apparatus.

There are genera which resemble *Cyrnotheba* in as far as lack digitiform glands and stylophores, ascribed to the subfamilies Euomphaliinae (sensu Schileyko, 1978b) (*Ashfordia*, *Monacha (Szentgalia)*), Metafruticicolinae (sensu Schileyko, 1972c, 1978b) (*Metafruticicola*, *Caucasocressa*, *Cretigena*, see Schileyko, 1972b, 1972c, 1978b) and Ciliellinae (sensu Schyleiko, 1972b) (*Ciliella*).

The structure of the glans and shell microsculpture with many other minute features characterize *Cyrnotheba* from *Ashfordia*, *M. (Szentgalia)* and *Ciliella*. It is also distinguished from the first two because of the r.o. retractor passing between penis and vagina. The major development of its vagina, the gametolytic gland duct which does not widen at its beginning, and its different glans structure distinguish *Cyrnotheba* from *Metafruticicola*, *Caucasocressa* and *Cretigena*.

An entity of Russian fauna, incomprehensively considered by Schileyko (1972c, 1978b) to be a subspecies of *Circassina circassica* (Mousson) (a species having digitiform glands and stylophores), is decidedly closer to the genus *Cyrnotheba*. We refer to «*C. circassica*» *simpla* (Schileyko (1972a), a species characterized by genital apparatus lacking digitiform glands and stylophores, with the vagina almost as long as the penis and the initial part of the bursa copulatrix canal not widened. The only anatomical differences from *Cyrnotheba* lie in the glans, which in «*C. c.*» *simpla* has an apical aperture, and the vagina which in «*C. c.*» *simpla* has internal rows of papillae (see SCHILEYKO, 1972a: Figs. 7-11; 1978b: Figs. 297-301).

This analysis has shown us how most of the anatomical characters listed can be fairly considered unsignificant and their use for differentiating species to the rank of genus may be subjective. If this is so, clearly no anatomical or shell feature has superior prerogative and consequently the whole systematic order of the helicids could be considered unsound (see conclusions of present paper). It is our belief that the anatomical characters wich distinguish *Cyrnotheba* evolved from ancestors different from those of the above apparently similar genera. It seems likely that genital ducts without any of the various vaginal accessory organs evolved by parallelism from different ancestral situations. Genera such as *Hygromia* and *Monachoides* may be ancestors of *Cyrnotheba*.

## *Cyrnotheba corsica* (SHUTTLEWORTH)

(Figs. 4-5; Pl. 3: Figs. A-E; Pl. 4: Figs. A-F; Pl. 9: Figs. A-E; Pl. 12: Fig. E; Pl. 14: Figs. A-D).

*Helix Corsica* SHUTTLEWORTH, 1843. *Mitt. naturf. Ges. Bern,* **2:** 15. Locus typicus: «bei Aleria» (Corsica).
*Helix Corsica*, REQUIEN, 1848. Cat. Coquilles Corse: 45.
*Helix Corsica*, SHUTTLEWORTH, 1852. *Mitt. naturf. Ges. Bern,* **260-261:** 294-295 (partim).
*Helix Corsica*, PFEIFFER, 1853. Mon. Hel. viv., **3:** 637 (partim).
*Helix (Zenobia) corsica*, MOQUIN TANDON, 1855. Hist. Moll. terr. fluv. France, **2:** 214-215; **3:** Pl. 16: Fig. 37 (?).
*Helix (Fruticicola) corsica*, ALBERS, 1860. Heliceen Verwandt.: 104 (partim).
*Helix (Fruticicola, Zenobia) corsica*, KOBELT, 1871. Cat. Binn.: 10 (partim).
*Helix (Arichia)* (sic!) *Corsica*, PAULUCCI, 1882. *Bull. Soc. malac. it.*, **8:** 200-201 (partim).
*Helix (Helicella, Fruticicola, Trichia) Corsica*, TRYON, 1887. Manual Conch. Pulmonata, (II) **3:** 180 (partim).
*Helix (Fruticicola, Trichia) corsica*, WESTERLUND, 1889. *Fauna paläarct. Reg. Binn.*, **2:** 64 (partim).
*Helix (Trichia) corsica*, KOBELT, 1890. Icon. Land-Suss.-Moll., (N.F.) **5:** 4-5 (partim).
*Hygromia (Fruticicola) corsica*, PILSBRY, 1895. Manual Conch. Pulmonata, (II) **9:** 273 (partim).
*Helix (Theba) Bastitensis* CAZIOT, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 105-106, Pl. 1: Figs. 1-1a-1b. Locus typicus restrictus: Bastia (Corsica).
*Theba bastitensis*, BÜTTNER, 1926. *Mitt. Zool. Mus. Berlin*, **12** (2): 235-236 + Fig.
*Theba* (s. str.) *cemenelea*, GERMAIN, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 272-277 (partim, non RISSO, 1826).
*Theba (Cyrnotheba) corsica*, GERMAIN, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 282-283 (partim).
*Theba* (s. str.) *cemenelea*, GERMAIN, 1930. Faune France, **21:** 265-266 (partim non RISSO, 1826).
*Theba (Cyrnotheba) corsica*, GERMAIN, 1930. Faune France, **21:** 268, Fig. 207 (partim).
*Cyrnotheba corsica*, HESSE, 1931. *Zoologica*, **81:** 42.
*Cyrnotheba bastitensis*, HESSE, 1931. *Zoologica*, **81:** 42, Pl. 13: Fig. 110.
*Theba (Cyrnotheba) corsica*, ALZONA, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 184 (partim).
*Theba (Cyrnotheba) bastitensis*, ALZONA, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat., Milano,* **111:** 184.
*Monacha cantiana*, HOLYOAK, 1983. *J. Conch. London*, **31:** 246 (partim, non MONTAGU, 1803).
*Monacha corsica*, HOLYOAK, 1983. *J. Conch. London*, **31:** 246 (partim).

## Material examined:

**Corsica:** 1) Aleria, Blauner leg., Lectotypus + 1 Paralectotypus of *H. corsica* Shuttleworth. Shuttleworth Coll., NMB 709; 2) Albertacce, 23.7.1979 (n); 3) Asco, (1) Caziot det. *H. bastitensis*. Ex Caziot Coll., MNHNP; 4) Bastia, Lectotypus of *H. bastitensis* Caziot Ex Caziot Coll., NMW 48470; 5) Bastia, 2 Paralectotypi of *H. bastitensis* Caziot. Ex Caziot Coll., SMF 69131 and 98772; 6) Bastia, 4 Paralectotypi of *H. bastitensis* Caziot. Ex Caziot Coll., MHNM; 7) Bastia, 1 Paralectotypus of *H. bastitensis* Caziot. Ex Caziot Coll., MNHNP; 8) Bastia, (1) Zilch (1960) det. *M. (C.) corsica*. Ex Boettger Coll., 1910, SMF 98768; 9) near Bastia, 29.11.1983, (4); 10) Bonifatto near Calvi, (1) det. *M. (C.) corsica*. SMF 69120; 11) Casalabriva, 22.4.1980, (4); 12) Corte, Pinter leg. 11.8.1977, 27.8.1980, (n); 13) Défilé de Lancone, 20.4.1980, (3); 14) Fango Valley, 23.7.1979 (2); 15) Fôret de Cervello, 21.4.1980 (1); 16) Forêt de u Coscione, 21.4.1980 (4); 17) Forêt de Marmano, 21.4.1980 (n); 18) Fôret de l'Ospedaletto, near Diamante, Lanza & Moggi leg. 10.8.1977 (1); 19) Fôret de la Restonica, slopes of Monte Cardo, 24.7.1979 (n); 20) Fôret de la Sorba, 21.4.1980 (4); 21) Fôret de Valdoniello, 23.7.1979, 7.4.1980 (n); 22) Korsika, (2) det. *M. (C.) corsica*. Ex Moellendorff Coll., 30.6.1913, SMF 69123; 23) near Olmeto, 1.12.1983, (n); 24) Omessa, (3) det. *M. (C.) corsica* erh ols. var. *mediterranea (nomen in schedula)*. Ex Revelier Coll., SMF 69122; 25) Pioggiola, 3.12.1983, (4); 26) Porto, 2.8.1982, (3); 26) St. Pierre de Venaco, Vallon de la Toffa a 1200 m d'alt., Hagen-Muller leg., (10) MHNM; 27) St. Pierre de Venaco, Flancs du Cardo de 600 a 1000 metres dans les mousses humides en remontand le Minuto a partir des dernieres maisons de village, Hagenmuller leg. (n). MHNM; 28) near Ucciani, Holyoak, leg. 15.4.1977 (2); 29) Vizzavona, (3) det. *T. bastitensis*. NMW 32r8; 30) Zigliara, 30.12.1983 (1).

## Historical Notes

Shuttleworth (1843) described the species on the basis of two specimens collected near Aleria in Corsica. The specimens were traced to the Naturhistorisches Museum of Bern (Pl. 3: Figs. A-B). Many later authors refer to *H. corsica*, but almost without further study. Shuttleworth (1852) redescribed the species and added that it is also found in Sardinia. Moquin-Tandon (1855: 215) published the first data on the genital tract, with the following distinguishing features: «fourreau de la verge assez long, étroit, atténué et subulé dans sa moitié supérieure. Flagellum assez long, très grèle, presque capillaire, pointu, contourné sur lui-même. Bourse à dard et vesicules moqueuses nulles. Poche copulatrice grande, obovée, pourvue d'un canal un peu long. Point de branche copulatrice». Moquin-Tandon also provided an excellent description of shell characters, defining the major differences between this and the closest species *Helix limbata* Draparnaud. He also published a drawing (1885, **3:** Pl. 16: Fig. 37) which seems to disagree with the text (*C. corsica* does, however, sometimes have a globular shell with the last whorl unangled).

Adami (1876) and Paulucci (1882) seem to confirm the presence of *H. corsica* in Sardinia. Paulucci's drawing is of Sardinian material (Pl. 3: Figs. 5, 5a, 5b) and appears to correspond to Shuttleworth's and Moquin-Tandon's descriptions. In actual fact, *H. corsica* sensu Adami (1876) which partly corresponds to *H. corsica* sensu Paulucci (1882), is not Shuttleworth's species and belongs to a problematical taxon which will be discussed later in this note (part of *H. corsica* sensu Paulucci 1882 belongs to a new species which will be described later). Caziot (1902) taking Shuttleworth's (1852) diagnosis, notified the presence of the species in different parts of Corsica and after remarking that ADAMI (1876) had also found it in Sardinia, denied that *H. corsica* sensu PAULUCCI (1882) was the same as SHUTTLEWORTH's species. For CAZIOT, the true *H. corsica* must have been very close to «*Helix carthusiana*» as described by DRAPARNAUD (1805, Pl. 6: Fig. 33) (= *H. cantiana* MONTAGU). Thus *H. corsica* sensu CAZIOT (1902) may not be the true one but may be *Monacha cantiana* (MONTAGU), a species common in Corsica. This is why CAZIOT's species is not listed among the synonyms of *C. corsica* but those of *M. cantiana*. This conclusion is confirmed by the fact that CAZIOT (1902) described a helicid collected at Bastia and in other Corsican localities as new. This same helicid was revealed to be a junior synonym of *H. corsica* SHUTTLEWORTH by our type analysis. We refer to *Helix bastitensis*. Eight tubes of material collected at Bastia have been traced in different collections. Each tube contains one or more specimens labelled by CAZIOT or indicating the CAZIOT Collection. One of the specimens (NHMW 6493) is a *Hygromia (Riedelia) limbata* (DRAPARNAUD), certainly alien to Corsican fauna; another (SMF 69130) is a *M. cantiana* (MONTAGU) (these specimens may have been the object of exchange of material); the rest (MHNM, two tubes; MNHNP, one tube; NHMW 48470; SMF 98772 and SMF 69131) are specimens of *C. corsica*.

As one of the latter (NHMW 48470) clearly corresponds to the one illustrated by CAZIOT (1902, Pl. 1: Figs. 2,2a, 2b) for his new species, we elect it lectotypus of *H. bastitensis* (Pl. 3: Fig. D) which thus becomes a junior synonym of *C. corsica*. The other specimens are elected as paralectotypi.

After CAZIOT (1902), BÜTTNER (1926) was the first to examine several specimens believed to belong to *H. bastitensis* collected in the Forêt de Aitone and at Vizzavona. BÜTTNER supplied some anatomical details of the species and a drawing of the genital tract received from HESSE. The description and the drawing do not agree with any of the entities known at the time and show curious features e.g. the digitiform glands, stylophores and penial retractor muscle are missing while a sort of appendicula vaginalis is clearly evident! From our studies in Corsica it is clear that no species exists with such a genital tract and therefore the drawing of HESSE in BÜTTNER (1926) is wrong. We believe that the genital tract in question belongs to specimens of *C. corsica*, the only small helicid of this group still present in the Forêt de Valdoniello, Aitone and Vizzavona. We think it unlike that this genital tract belongs to *M. cantiana* because while there is an appendicula vaginalis and no penial retractor, all the other characters agree with those of *C. corsica*: absence of digitiform glands; long slender gametolytic gland duct; oval gametolytic gland; very long slender penis, moderately long penial flagellum and vagina. Presumably HESSE examined a poorly preserved specimen from which the penial retractor muscle was torn away during dissection (as he suspected, cfr. BÜTTNER, 1926; HESSE, 1931). It is more difficult to understand how HESSE could have drawn an appendicula vaginalis. Perhaps it was a part of the retractor muscle of the genital atrium (cfr. Fig. 4B-C, E), as suggested by the unnatural collocation of the «appendicula vaginalis» (at the genital atrium instead of the vagina in HESSE's drawing).

An alternative hypothesis is that the genital tract illustrated by Hesse in Büttner belongs to a very young specimen of *M. cantiana* with immature and thus longer parts and as yet undeveloped digitiform glands. Nevertheless in such specimens the outline of the appendicula vaginalis is shorter and never inserted in the genital atrium but about half way up the vagina (Fig. 2B).

Germain (1929, 1930) considered Caziot's *H. bastitensis* to be a certain synonym of *Theba cemenelea* Risso (= *M. cantiana* Montagu), and later Holyoak (1983) was of the same opinion. Germain (1930) exactly copied the anatomical drawing in Büttner but attributed it to *T. (Cyrnotheba) corsica*, for the reasons set out in Germain (1929: 422). The apparent similarity between the first anatomical description of *H. corsica* by Moquin-Tandon (1855) and Büttner's illustration (1926) conceived Germain that *H. bastitensis* sensu Büttner (not Caziot, 1902) must be *H. corsica*. Despite this Hesse (1931) reverted to considering «*Cyrnotheba bastitensis*» as a separate species, distinct from *C. corsica* and *Theba cantiana* (and *Theba cemenelea* which he also considered a separate species).

## Description and Comments

As for the genus *Cyrnotheba*, we give an up-to-date description of *C. corsica* according to our findings.

***Shell***: medium sized, globular or sub-globular shell (Pl. 3: Figs. A-B, D; Pl. 4: Figs. A-F) with a conic-convex spire of variable height formed by 5 to $5^{1}/_{2}$ regularly increasing whorls; the last whorl is almost always angled, sometimes keeled; moderately deep sutures; small umbilicus usually covered by the columellar margin of the peristome; elliptical mouth with a thin slightly reflexed peristomal margin; slightly translucent whorls varing in colour from pale yellow, through yellow to brown, with a thick periostracal covering lined by many transverse striae. The external surface of the protoconch (Pl. 9: Figs. A-B) has spiral rows of small tubercles, and that onnis,f the teleoconch (Pl. 9: Figs. C-E) transverse series of nail-like scales and many minute longitudinal crests, which are frequently interrupted or broken into lines of small drop-like structures. Tubercles and scales lie on the relief surface of the mineralized layer. Dimensions: max. diam. = 12-15.6 mm, h. = 9-12.5 mm.

***Genital Tract*** (Figs. 4-5): a long slender convoluted first hermaphrodite duct extends from the hermaphrodite gonad. The duct ends in the «talon» (seminal receptacles plus fertilization chamber complex). The talon lies on the inner side of the basal portion of the long albumen gland at the beginning of the second hermaphrodite duct (ovispermiduct), the female portion of which is well developed and multilobate and ends anteriorly in a short (2.9-5.2 mm) uterine canal (the free oviduct) which leads to the vagina.

The vagina takes the form of a long (8.2-11.3 mm) cylindrical canal. The long canal of the bursa copulatrix (gametolytic gland duct) arises at the base of the vagina where the uterine canal ends. The bursa copulatrix is of variable width and oval in shape. The long slender vas deferens arises at the apex of the prostatic portion of the ovispermiduct and terminates at the base of the epiphallus, thus defining a flagellum of variable lenght in the different populations. The terminal part of the vas deferens adheres to the penial walls by means of a bundle of connective fibres. The epiphallus, or rather the portion of the penial complex which starts where the vas deferens ends and terminates at the attachment of the penial retractor muscle, is commonly bent back upon itself. The portion of the penial complex between the attachment of the penial retractor and the genital atrium is fairly short and wide. Its proximal portion is continuous with the epihallus and adheres to its walls by a series of connective bundles. The limits of the distal portion of the penis are defined by an annular constriction. The penial papilla (= glans) is situated inside the distal portion of the penis, has wrinkled walls, a subapical opening and is long and cylindrical in shape. In transerve section the penial papilla is seen as an external sheath bounding an empty cavity through the centre of which lies a canal with wrinkled walls. In specimens which died with the penis everted the glans appears wider than it is long, with a recorder-like apex and subapical opening. The inner walls of the epiphallus like those of the vagina are formed with a series of longitudinal wavy crests of varying width which occasionaly branch. These crests continue into the proximal portion of the penis and end in the inner canal of the glans. Spermatophores found in the bursa copulatrix, have a transverse section which varies from triangular at the head to circular in the middle and at the tail. One side of the triangle has four longitudinal crests. Penis and vagina open into a short genital atrium. A series of bundles of muscle fibres extends from the inner surface of the body wall surrounding the genital atrium to join the columellar muscle. The bundle nearest the genital atrium may be considered the genital atrium retractor. Another muscle, the right ommatophore retractor (r.o. retractor) passes between penis and vagina. All the specimens dissected had a penial retractor but neither digitiform glands nor stylophores (= dart sacs). The mean dimensions of the various portions of the genital tract in 13 specimens were as follows: vagina: 6.3-11.3 mm ($\bar{m}$ = 9.54); penis (from the base of the penial retractor to the genital atrium): 6.2-11.5 mm ($\bar{m}$ = 9.23); epiphallus (from the base of the penial retractor to the end of the vas deferens): 6.4-16 mm ($\bar{m}$ = 10.6); penial flagellum: 2.9-28.2 mm ($\bar{m}$ = 16.23); bursa copulatrix + its duct: 11.3-29 mm ($\bar{m}$ = 18.78); free oviduct: 2.9-5.2 mm ($\bar{m}$ = 4.04). The remarkable variations in dimension of some tracts of the genital apparatus between different populations is certainly worthy of note! However, the shortage of completely sexually mature specimens in our possession prevents us from drawing exact conclusions. Given the limited vagility of the species, it is not impossible that different populations have, in time, genetically differentiated to the point of manifesting small morphological peculiarities. We may therefore be dealing with a group of subspecies or twin biological species which cannot be distinguished from each other by morphological analysis alone.

**Fig. 4** - *Cyrnotheba corsica* (SHUTTLEWORTH). The genital duct (gonad excluded) in specimens collected in Corsica near Albertacce (A); Forêt de u Coscione (B); Pioggiola (C); Ucciani (HOLYOAK leg.) (D); Olmeto (E). Note the different lengths of the penial flagellum (Symbols as in Fig. 1).

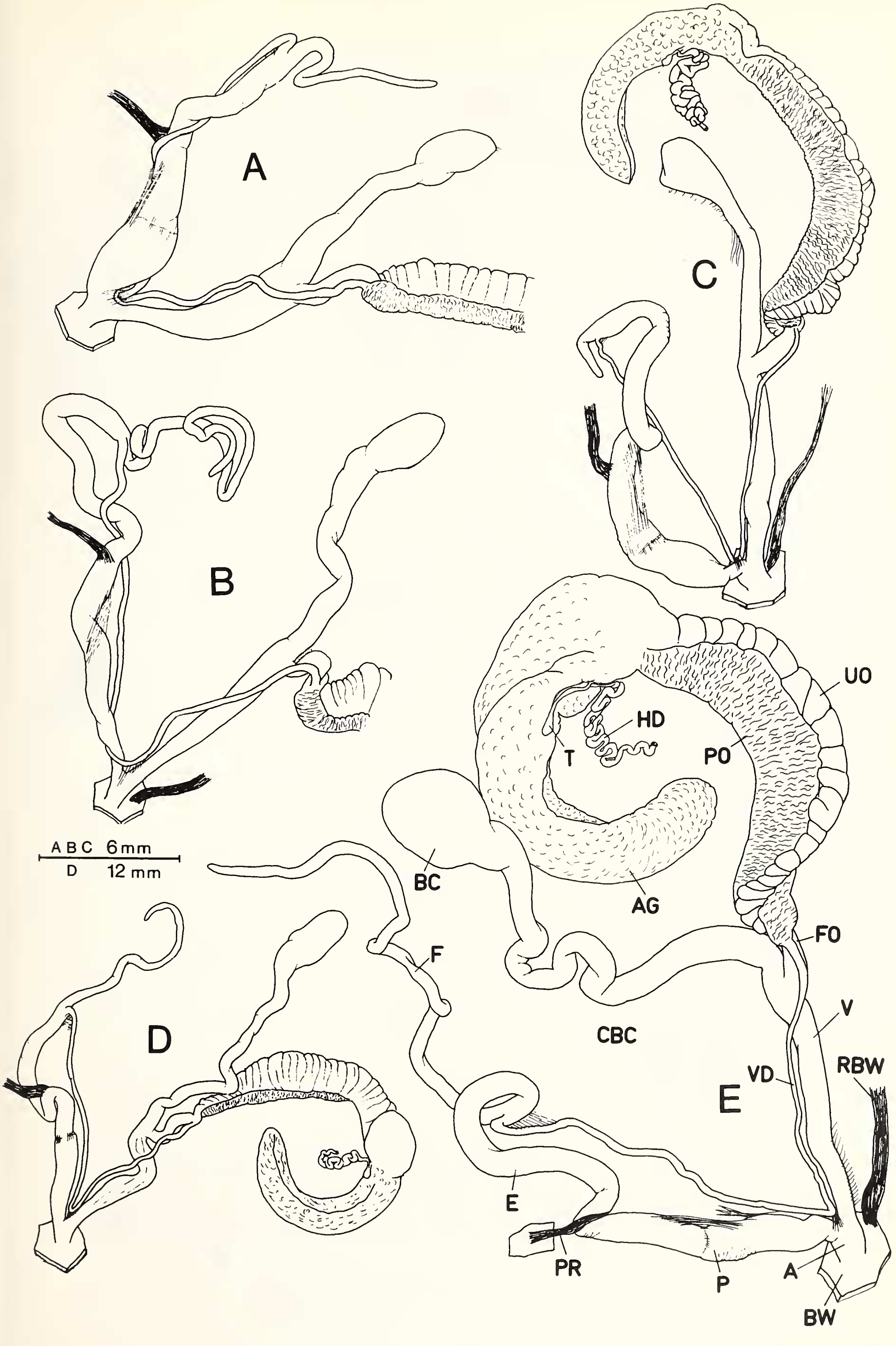


Fig. 4

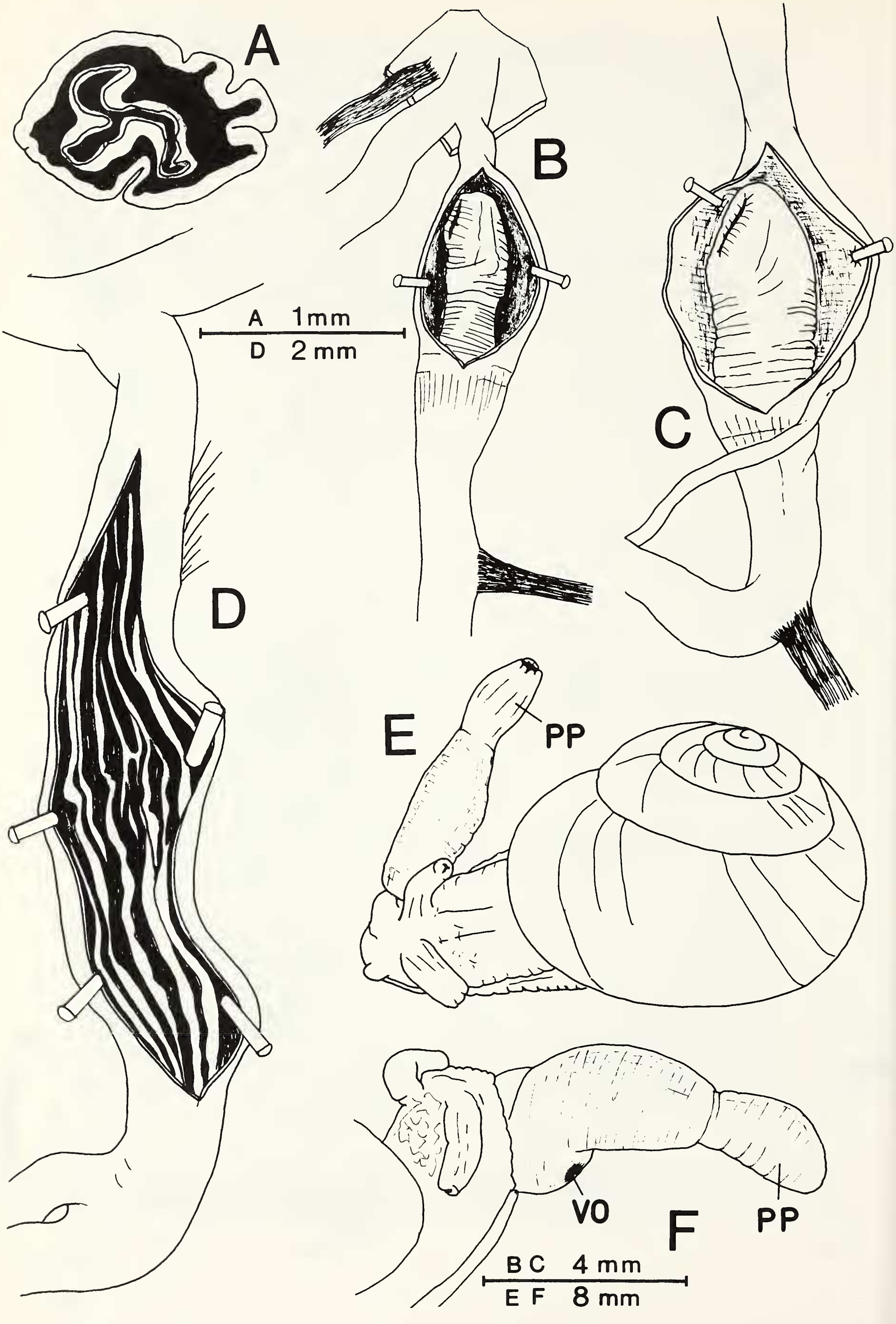


Fig. 5

***Radula*** (Pl. 14: Figs. A-D): the radula has numerous rows of teeth, each bearing teeth according to the formula 30-40+C+30-40. The central tooth has a wide basal plate with prominent pointed upper vertices. The apex of the tooth has a wide pointed mesocone and two very small, sometimes almost invisible ectocones. The first lateral teeth also have a well defined basal plate but with only one prominent pointed upper vertex (outermost). The apex of the lateral teeth is constituted by a wide robust mesocone and a tiny ectocone. The mesocone sometimes has a slight protuberance on its inner side. This may be a sign of the second point that the mesocone apex develops in the latero-marginal teeth. Proceeding outwards, the lateral teeth gradually become smaller with more slender pointed cusps and less evident basal plate. At about 17th-21st tooth the mesocone begins to have a double apex. The extreme marginal teeth have mesocones with a distinctly double apex and more slender pointed ectocones, often also with two points.

### Zoogeographical and Ecological Notes

*C. corsica* (SHUTTLEWORTH) is a well defined species endemic of the island of Corsica. It appears to be a palaeoendemic species derived by reduction of vaginal annexed structures (digitiform glands and stylophores) from an unidentifiable Hygromiinae living in the western sector of the Palaeoeuropean Continent in the lower Tertiary. It apparently survived to geological events which caused the Sardo-Corsican complex to break away from the southwestern edge of the Palaeoeuropean Continent in the Middle-Tertiary (upper Eocene - lower Oligocene) (GIUSTI & MANGANELLI, 1984). The species may be found in central and northern Corsica, but it is not common. It is usually collected among fallen leaves, under stones and fallen tree trunks at variable altitude both in forests of latifoliae and macchia-conifer vegetation.

## Genus *Hygromia* RISSO, 1826.

In recent years the classification of the genus *Hygromia* has undergone many changes. Researchers have given different interpretations to anatomical details, have studied them in varying degrees of detail and have generally attached little importance to shell features which apparently tend too often to converge. This has resulted in many different positions and splitters and lumpers have clashed repeatedly without succeeding in giving convincing status.

**Fig. 5** - *Cyrnotheba corsica* (SHUTTLEWORTH). Various portions of the genital duct in specimens collected in Corsica in the Forêt de Marmano (A); Pioggiola (B); Fango Valley (C); Ucciani (HOLYOAK leg.) (D); Albertacce (E) and Forêt de Restonica (F). A: transverse section through the central portion of the penial papilla; B-C: the penis is opened to show the penial papilla; D: the vagina is opened to show its inner structure; E-F: the penis is everted (Symbols as in Fig. 1).

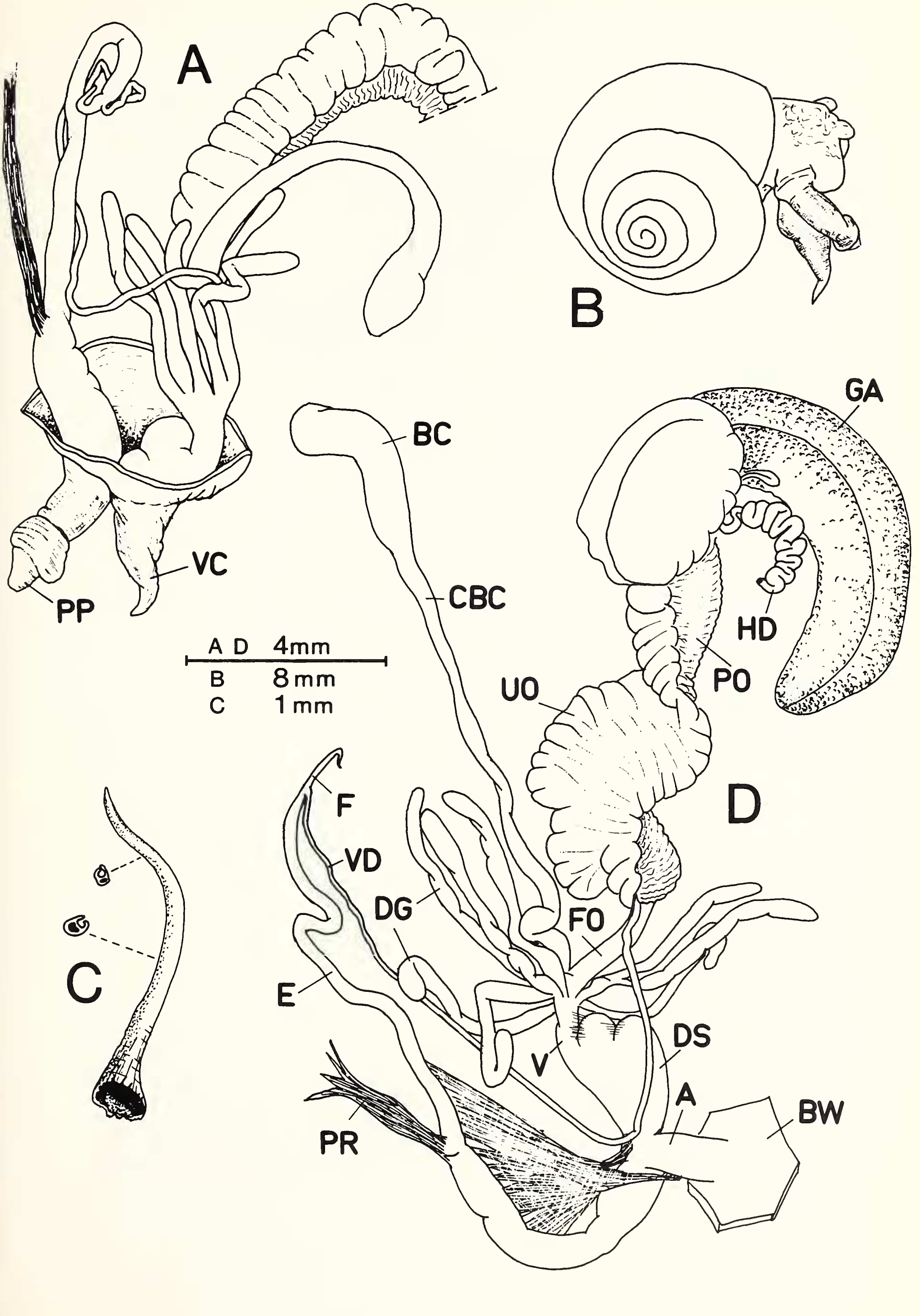
WATSON (1919) divided the subgenus *Hygromia* (s. str.) into two parts: one including *Helix fusca* (MONTAGU) (= *Helix subrufescens* MILLER) and the other including *H. cinctella* and *H. limbata.* In 1921 GUDE & WOODWARD introduced the genus *Zenobiella* for *H. subrufescens.* HESSE (1921) considered the genus *Hygromia* to contain only *H. cinctella* and *H. limbata.* In the same publication he created the genus *Pyrenaearia* for a group of species anatomically similar to the *Hygromia,* living at high altitudes in the Pyrenées.

LINDHOLM (1927) also considered *Hygromia* to include only *H. cinctella* and *H. limbata. Zenobiella* and *Pyrenaearia* remained separate genera. HESSE (1931) divided *Hygromia* into sections: *Hygromia* (s. str.) and *Zenobiella,* thus agreeing with WATSON (1919). In the same paper HESSE included *Helix lanuginosa* BOISSY in the genus *Monacha* and left *Pyrenaearia* as a separate genus. WATSON (1943) returned to the subject and divided *Hygromia* into the following subgenera: *Hygromia* (s. str.), *Zenobiella, Monachoides* GUDE & WOODWARD, 1921, *Trichia* HARTMANN, 1840. FORCART (1954) concluded that neither *Monachoides* nor *Trichia* belonged to the genus *Hygromia* and that *Zenobiella* and *Pyrenaearia* were not sufficiently differentiated from it to stand alone. According to FORCART *Hygromia* included only *Hygromia* (s. str.), *Pyrenaearia* and *Zenobiella.* In the same note FORCART revised the position of *Helix lanuginosa,* placing it in the genus *Hygromia* and in the typical subgenus.

ORTIZ DE ZARATE Y LOPEZ (1956) agreed with the distinction between *Pyrenaearia* and *Hygromia.* ZILCH (1960) considered *Zenobiella* and *Pyrenaearia* as separate genera leaving *Hygromia* without subgenera. HUDEC (1970) created a new subgenus *Lozekia* for *Helix transsylvanica* WESTERLUND. At the same time GITTENBERGER (1970) created a new subgenus *Ganula* (see also GITTENBERGER 1971) for *Hygromia lanuginosa.* SCHILEYKO (1970) suggests that *Zenobiella* was a junior synonym for *Hygromia* and agreed with the genus *Pyrenaearia.* He also described a new genus *Archaica* divided into two subgenera: *Archaica* (s. str.) and *Euarchaica,* for several species having genital apparatus similar to that of *Hygromia,* but living in Asia.

SCHILEYKO (1972a) further divided the genus *Hygromia* into subgenus *Hygromia* (s. str.) leaving in it only *H. cinctella*; he included *H. limbata* in the new subgenus *Riedelia.* At the same time VARGA & PINTER (1972) consider *Ganula* and the genus *Archaica* as junior synonyms for *Lozekia,* recognising only the following subgenera of the genus *Hygromia:*
*Hygromia* (s. str.): two stylophores of similar size; only one twisted dart; very short almost rudimentary penial flagellum.
*Pyrenaearia*: two stylophores of similar size; only one very short almost straight dart; fairly short to very long penial flagellum.
*Lozekia*: two stylophores of different size; only one arched dart; proportionally long penial flagellum.

**Fig. 6** - *Hygromia* (s. str.) *cinctella* (DRAPARNAUD). The genital duct (gonad excluded) and the dart in two specimens from Ghisonaccia (Corsica). A-B: the distal portion of the genital duct is everted. Note the large vaginal cone through which the dart is shooted; C: the twisted dart and two transverse sections at different levels; D: a genital duct in normal situation (Symbols as in Fig. 1).


A
PP
VC
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GA
HD
PO
UO
A D 4mm
B 8mm
C 1mm
D
F
VD
DG
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C
E
DS
V
A
BW
PR

Fig. 6

In later studies Schileyko (1972b, 1972c, 1973, 1978a, 1978b) unfolds his vision of the classification of the Helicoidea, abolishing the classical division between subfamilies Hygromiinae and Helicellinae. He considered the latter an unnatural group and included them in the Hygromiinae, which he promoted to the status of family (Hygromiidae) and divided into no less than nine subfamilies. Of Hygromiinae, the genus *Hygromia* proper is therefore limited to central-western Europe. Unfortunately Schileyko did not comment on the classification of the genus proposed by Varga & Pinter (1972). Nevertheless the fact that he kept *Archaica* as a separate genus appears to indicate that he intends *Lozekia* to be a separate subgenus, not necessarily synonymous with *Ganula* (see also Schileyko, 1978b: 68). Finally Varga (1979) maintained the division of *Hygromia* into the subgenera *Lozekia*, *Pyrenaearia* and *Hygromia* (s. str.), but admitted that this division was not without its problems and required further investigation.

After all this, it is perfectly understandable that it is not an easy matter to formulate an opinion on the division of the genus *Hygromia*. Our first impression is that some of anatomical characters used so far for classification are too liable to random variation and convergence to be used in the definition of superspecific taxa. As the same can be said for the shell characters, we are forced to purpose three alternative possibilities:

1) consider *Hygromia* as a very polymorphic taxon not yet divisible into sufficiently characterized subgenera;

2) consider all the subgenera of *Hygromia* so far described as separate genera, including species that must have differentiated independently in different areas from a common basal group, acquiring similar anatomical characters by chance;

3) consider a compraise in which *Hygromia* includes only forms with the clearest shell and anatomical similarity such as the «subgenera» *Hygromia* (s. str.) and *Riedelia*. *Lozekia*, *Ganula*, *Pyrenaearia* and *Zenobiella* remain as separate genera.

We think solution 3) is the most acceptable but we realize that its adoption is an act of faith. There are still too many aspects to investigate and points to clear up. It is crucial to estabilish with greater certainly the relation between *Lozekia* and *Hygromia*; check whether *H. kovacsi* of Hungary is the same as *Pyrenaearia*; determine the value of each anatomical character and whether all shell features, not only form and strenght, should be discarded. It is also true that it is inappropriate to assume either the frankly acritical position 2) or 1) which would tend to hide the difficulties by lumping everything together.

Without claiming to have resolved the problem we propose the following tentative classification:

**Fig. 7** - *Hygromia* (s. str.) *cinctella* (Draparnaud). Various portions of the genital duct in specimens from Torcello (VE, Italy) (A) and Ghisonaccia (Corsica) (B-D). A: the vagina is opened to show the vaginal cone through which the dart is shooted; the basal opening of the vaginal cone usually appears closed by a strict adhesion of its two lips; a gentle traction is sufficient to open it; B, D: the penial papilla; C: digitiform glands; E: two sections of the penial papilla at different levels (Symbols as in Fig. 1).

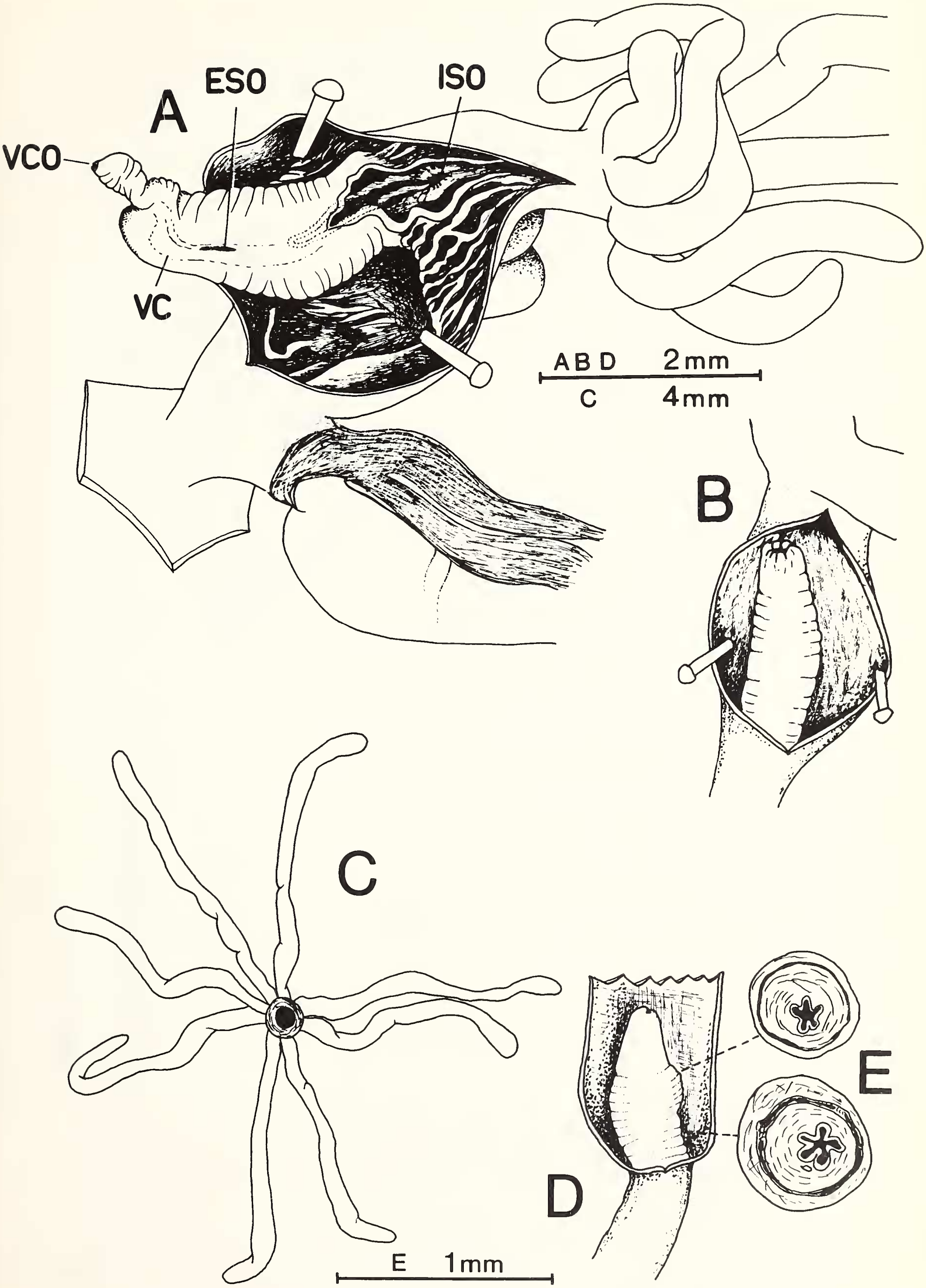


Fig. 7

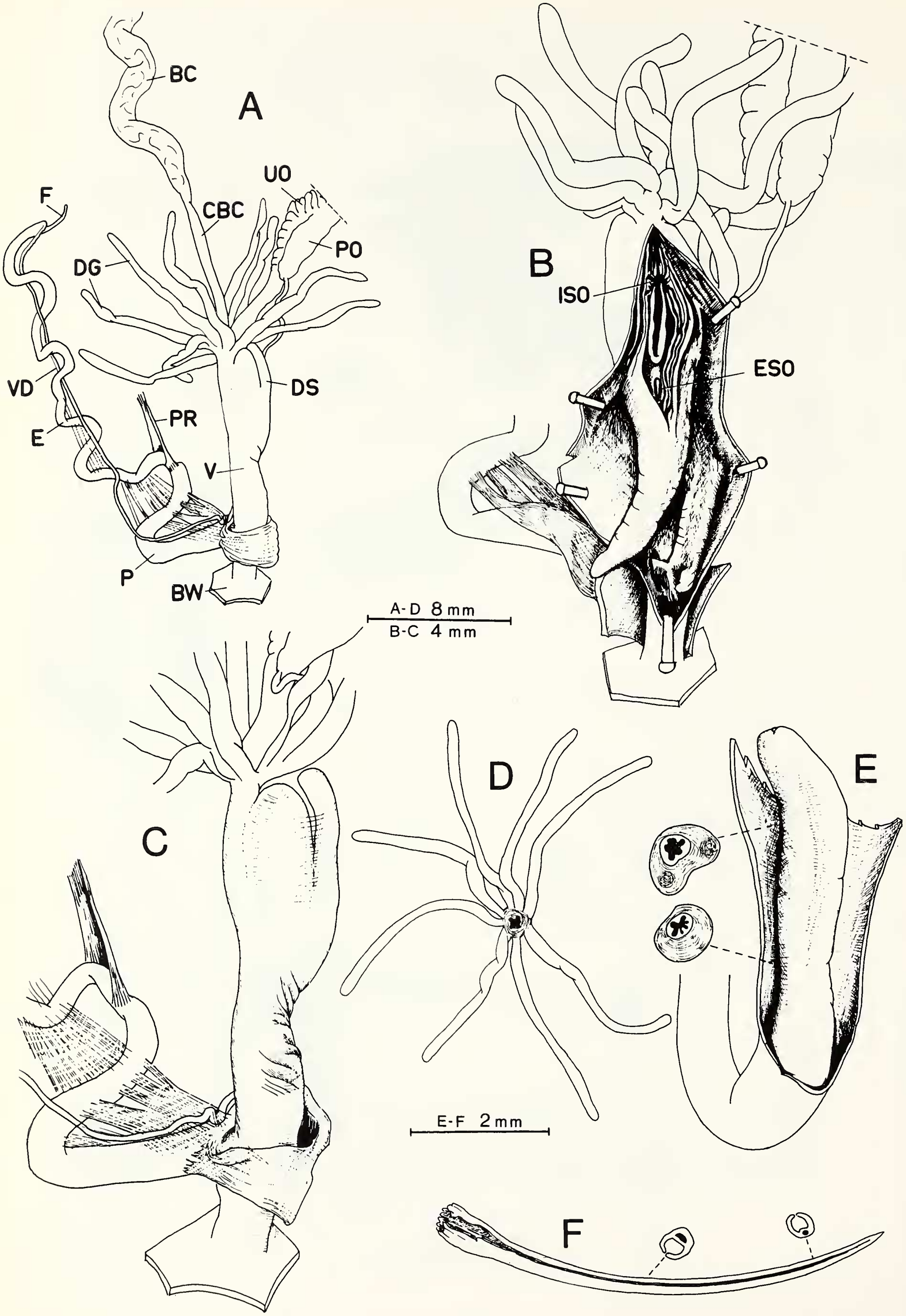

BC
A
UO
F
CBC
PO
DG
B
ISO
ESO
VD
DS
PR
E
V
P
BW
A-D 8 mm
B-C 4 mm
C
D
E
E-F 2 mm
F

Fig. 8

## Genus *Hygromia* Risso, 1826

Type-species: *Helix cinctella* Draparnaud, 1801, subsequent designation: Herrmannsen (1847).

Medium sized shell with 5-6 whorls increasing gradually and regularly, angled or keeled, translucid, variable in colour from pale-yellow to dark brown, often with a paler band coinciding with the peripheral angle or the keel. Small or very small umbilicus; thin or slightly thickened, slightly or non reflexed peristome. The external surface of the periostracal layer of the teleoconch has transverse rows of small nail-like scales.

The genital duct is characterized by a short proximal vagina, two stylophores of variable size, the dart cavities of which open one above the other on the same side of a conical structure open at its base, which extends into the vagina; the external stylophore has a twisted or arched dart with A-shaped transverse section; the penis is no longer than the epiphallus. There are digitiform glands; the bursa copulatrix duct is longer than the vagina; the penial papilla (glans) is medium to long with an apical opening and only one central canal sometimes with a ring of small lacunae in its walls. The penial flagellum is short to very short and the r.o. retractor passes between penis and vagina.

The genus can be subdivided into the following subgenera:

*Hygromia* (s. str.): two stylophores of equal size; twisted dart; large oval bursa copulatrix with a fairly long duct; penis and epiphallus of medium lenght. Only one species included: *H.* (s. str.) *cinctella* (Draparnaud).

*Riedelia* Schileyko, 1972a: two stylophores, the external one slender and smaller than the internal one; arched dart; bursa copulatrix of variable lenght, usually long and slender, with a fairly short duct; very long and slender penis and epiphallus.

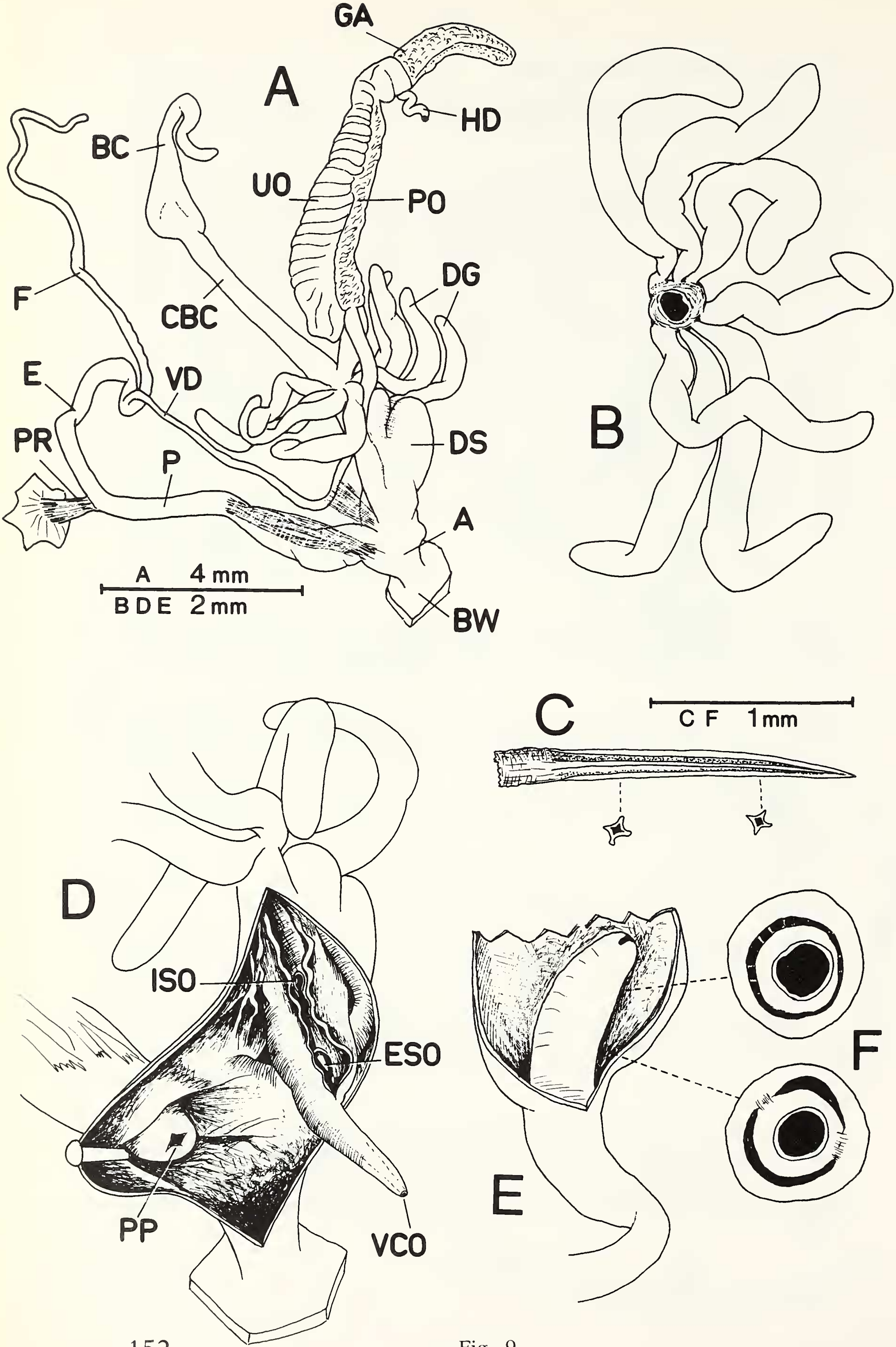
Type species: *H. (R.) limbata* (Draparnaud) (Figs. 8A-F, 16B; Pl.8: Figs. C-D).

## Genus *Lozekia* Hudec, 1970

Type-species: *Helix transsylvanica* Westerlund 1876, original designation.

Medium or small sized shell, with 5-5¼ whorls increasing gradually and regularly, globular or slightly flattened and angled, translucent, variable brown in colour; very small umbilicus partially covered by the col-

**Fig. 8** - *Hygromia (Riedelia) limbata.* (Draparnaud). The genital duct and some of its portions in a specimen from Macizo de Gorbea, S. of Arraba, 1000 m, Prieto leg. 8.4.1985. A: the genital duct (part of the ovispermiduct, albumen gland, gonad and part of the bursa copulatrix are excluded); B: the vagina is opened to show the vaginal cone; C: a detail of A; D: digitiform glands; E: the penial papilla and two sections at different levels; F: the dart and two of its transverse sections. (Symbols as in Fig. 1).


GA
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A 4 mm
B D E 2 mm
B
C
C F 1mm
D
ISO
ESO
PP
VCO
E
F

Fig. 9

umellar margin of the peristome which is not thickened nor reflexed. The external surface of the periostracal layer of the teleoconch has two types of microsculpture; transverse rows of small nail-like scales and minute narrow regularly spaced longitudinal crests. The genital duct is characterized by a very short proximal vagina, two stylophores of different size, the internal one noticeably smaller than the external one, both opening independently into the same cavity which in its turn opens into the vagina; only one slightly arched dart of undetermined transverse section in the external stylophore; digitiform glands present; bursa copulatrix duct longer than the vagina; penis as long as the epiphallus; penial papilla (glans) with apical opening and of undetermined transverse section; long or short penial flagellum (from VARGA, 1979). The r.o. retractor passes between penis and vagina.

At the present time it includes *L. transsylvanica* and *L. deubeli*. *«Hygromia» kovacsi* is difficult to classify and direct analysis is required before it can be placed in a subgenus of *Lozekia* or in a separate genus.

## Genus *Ganula* GITTENBERGER, 1970

Type-species: *Helix lanuginosa* BOISSY, original designation.

Shell of small to medium dimensions with 5-5$^1/_2$ whorls which increase gradually and regularly, globular, opaque, yellowish in colour with a paler band at the periphery of the last whorl; small umbilicus; not thickened, slightly or not reflexed peristome. The external surface of the periostracal layer of the teleoconch has two types of microsculpture: irregular rows of short hairs and minute narrow regularly spaced longitudinal crests which are often fragmented into rows of small drop-like structures.

The genital duct is characterized by a very short proximal vagina, two stylophores of different size, the inner smaller than the outer; the cavity of the inner stylophore ends in an independent opening located immediately above the opening of the outer stylophore. The stylophore side of the vagina is characterised by a pair of lips which fuse distally to surround the openings of the two stylophores. There is only one slightly arched dart of elliptic or rhombic transverse section which arises in the outer stylophore; digitiform glands present; bursa copulatrix duct same lenght as the vagina or slightly longer; penis of variable lenght: sometimes as long as epiphallus, sometimes shorter; short penial papilla (glans) having an apical opening, only one central canal and thick walls containing lacunae; short penial flagellum. The r.o. retractor passes between vagina and penis.

Only the type-species is included.

**Fig. 9** - *Zenobiella subrufescens* (MILLER). The genital duct and some of its portions in a specimen from Shipley Wood near Mulne Park, Alnwick (Northumberland, England, NORRIS leg.). A: the genital duct (gonad excluded); B: digitiform glands; C: dart and two of its transverse sections; D: the genital atrium and the vagina are opened to show the vaginal cone and the opening of the two stylophores. The tip of the dart is visible; E-F: the penial papilla and two of its transverse sections (Symbols as in Fig. 1).

## Genus *Pyrenaearia* Hesse, 1921

Type-species: *Helix carascalensis* Ferussac, 1821, original designation.

Shell of medium dimensions with 5-6 whorls which increase regularly, the last angled or keeled to a variable degree, variable depressed, subconvex superiorly, opaque, yellowish, reddish or greyish-white in colour, sometimes with a whitish marginal band and often yellowish blotches; small or large umbilicus sometimes partially covered by the columellar margin of the peristome; not thickened peristome, occasionally slightly reflexed. The microsculpture of the periostracal surface is unknown. Some species have periostracal hairs and sometimes the protoconch is patterned with a compact series of radial striae or growth lines. The genital duct (Figs. 10A-F, 16F) is characterised by a short of proximal vagina; two stylophores of equal size, the dart cavities of which end side by side in a single opening in the vaginal walls; only one almost straight dart of oval transverse section arising in the outer stylophore; digitiform glands present; bursa copulatrix duct longer than vagina; penis the same lenght as the epiphallus; short penial papilla with side opening, S-shaped section and lateral spermiduct, having compact walls without lacunae; penial flagellum from moderately long to long; r.o. retractor passes between penis and vagina.

Many species of the Pyrenées are included.

Before concluding this survey we should like to outline the problem of the genus *Zenobiella*. This genus was recently said to be synonymous with *Hygromia* by Schileyko (1970) while Gittenberger (in Kerney & Cameron, 1980) and Kerney et al. (1983) consider it a subgenus of *Perforatella*. Castillejo Murillo (1982) even considered it as a subgenus of *Monacha*. While these two opinions are clearly unjustified (*Z. subrufescens* has two evident stylophores!) that of Schileyko may be otherwise. *Zenobiella* is very similar to *Hygromia* both in shell and in anatomical characters. The periostracal layer of the external teleoconch has transversal rows of small nail-like scales. The genital duct (Figs. 9A-F, 16C) has two stylophores, the inner smaller than the outer which produces a dart. The dart cavities of the two stylophores open indipendently, one above the other on one side of a basally open conical structure which extends into the vagina. The r.o. retractor passes between penis and vagina. *Zenobiella* is distinguished from *Hygromia* by the following characters: slightly arched dart with Greek cross transverse section; penial flagellum from long to very long; transverse section of the penial papilla (= glans) showing two concentric rings separated by a moderately wide cavity, the outer being connected to the

**Fig. 10** - *Pyrenaearia carascalensis* (Ferussac). The genital duct and some of its portions in a specimen from Vie des Esperières near Gavarnie (Hautes Pyrénées, Bodon leg.). A: the penial papilla as seen on both sides; B: two transverse sections of the penial papilla; C: digitiform glands; D: dart and its transverse section; E: the genital duct (part of the ovispermiduct, albumen gland and gonad are excluded); F: the vagina is opened to show the inner structure; note the unique opening of the stylophores and the tip of the dart (Symbols as in Fig. 1).

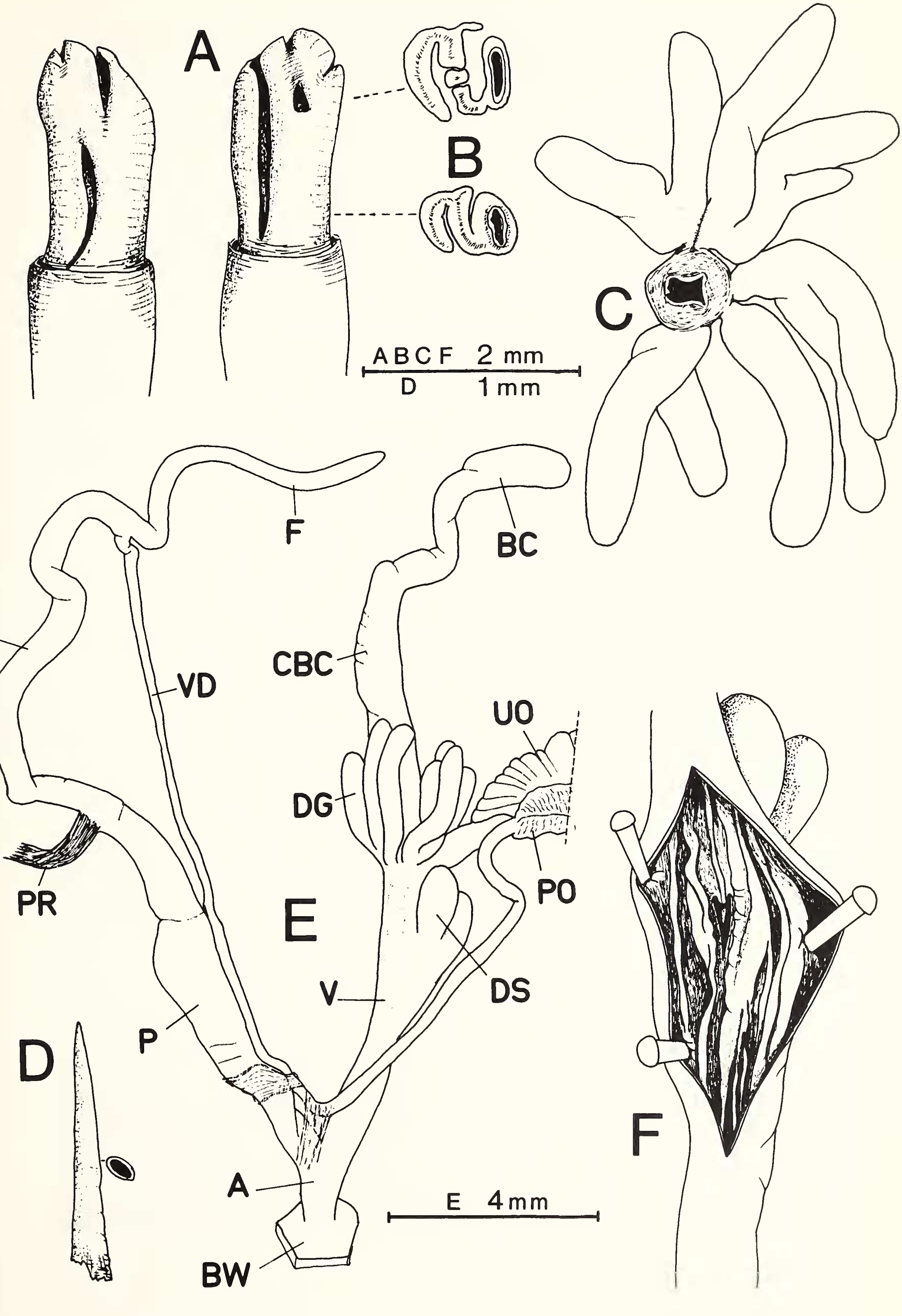


Fig. 10

inner ring into which the spermatic canal runs by thin connective bundles which are concentrated on opposite sides near the papilla base (Fig. 9F).

It is therefore our opinion that *Zenobiella* may be considered a separate genus among the Hygromiinae, and close to *Hygromia*.

## *Hygromia cinctella* (Draparnaud)

(Figs. 6-7; Fig. 16A; Pl. 8: Figs. E-F; Pl. 12: Fig. F; Pl. 13: Figs. D-F).

*Helix cinctella* Draparnaud, 1801. Tabl. Moll. France: 87.
*Helix cinctella*, Payraudeau, 1827. Cat. Ann. Moll. Corse: 100.
*Helix cinctella*, Shuttleworth, 1843. *Mitt. naturf. Ges. Bern*, **2:** 15.
*Helix Cinctella*, Requien, 1848. Cat. Coquilles Corse: 46.
*Helix (Zenobia) cinctella*, Moquin Tandon, 1855. Hist. nat. Moll. terr. fluv. France, **2:** 215-217; **3:** Pl. 16: Figs. 38-40.
*Helix (Hygromia) Cinctella*, Caziot, 1902. *Bull. Soc. Sci. hist. nat. Corse*: 110.
*Hygromia cinctella*, Germain, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 258-260, Pl. 11: Figs. 350, 354, 360-361.
*Hygromia cinctella*, Germain, 1930. Faune France, **21:** 258-259, Pl. 3: Figs. 63, 65.
*Hygromia* (s. str.) *cinctella*, Schileyko, 1972. *Zool. Zh.*, **51** (8): 1130, Fig. 1.
*Hygromia cinctella*, Alzona, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat. Milano,* **111:** 178.
*Hygromia cinctella*, Holyoak, 1983. *J. Conch. London*, **31:** 274.

### Material examined:

**Corsica:** 1) near Bastia, 29.11.1983, (6); 2) Cardo, 19.4.1980 (1); 3) Cap Corse, loc. Vic Carbonacce, 14.10.1982, (1); 4) Francardo, 21.4.1980, (1); 5) Ghisonaccia, 30.11.1983, (3); 6) Ghisoni, Taiti leg. 15.4.1981, (1); 7) Omessa, Bodon leg. 26.3.1984 (1).

### Historical Notes

*H. cinctella* was identified in Corsica by Payraudeau (1827), Shuttleworth (1843), Requien (1848), Caziot (1902), Germain (1929, 1930), Holyoak (1983). The species does not seem to be present in Sardinia. Except for Villa (1836 et in Paulucci 1882: 362), no other author of the past has ever included it in catalogues of Sardinian malacofauna. Recently Perjesi (1985) reports it in the province of Sassari, but without explaining what data he utilizes.

### Description and Comments

The shell and genital tract (Pl. 8: Figs. E-F; Figs. 6-7, 16A) of the Corsica specimens agree with those of specimens from various localities in Italy. A specimen which died in extension and with the end part of the genital apparatus everted revealed a glans with a wide cylindrical base and conical apex. No new character is shown by the radula (Pl. 13: Figs D-F). It consists of many rows of teeth each with approximately 53-55 teeth according to the formula 26-27+C+26-27. The central tooth has a robust basal plate with two distinct pointed upper vertices, and an apex with wide mesocone and two tiny ectocones. The first lateral teeth have an evident basal plate with only one (the external) distinct pointed vertex. The apex of the lateral teeth is formed by a wide mesocone and a small ectocone. The mesocone often has a small protuberance on the side facing the central tooth, being a first sign of the second point of the mesocone apex of the latero-marginal and marginal teeth. Moving laterally the teeth become progressively more slender with the mesocone curving inwardly and the basal plate progressively less evident. At about 11th to 13th lateral tooth, the mesocone begins to have a double apex. The extreme marginal teeth have a double mesocone and an ectocone with 2-4 points.

### Zoogeographical Notes

*H. cinctella* is distributed throughout south-western Europe including Corsica, the Tuscan Archipelago, all of the Italian peninsula and Sicily. The frequency with which it is found in heavily anthropized wet areas implies that it is easily subject to passive distribution. It therefore does not lend itself to zoogeographical analysis.

## Genus *Ganula* GITTENBERGER, 1970

Type species: *Helix lanuginosa* BOISSY, 1835, original designation (For Description and Comments see comments on genus *Hygromia*).

## *Ganula lanuginosa* (BOISSY)

(Fig. 11; Fig. 16E; Pl. 4: Fig. G; Pl. 10: Figs. D-F; Pl. 14: Figs. E-H).

*Helix lanuginosa* BOISSY, 1835 in GUERIN-MENEVILLE: *Magazine Zool.*, **5** (69): 2 pp, Pl. 69: Figs. a-b. Locus typicus «l'île Majorque à Palma».

? *Helix lanuginosa*, VILLA, 1836. Conchiglie ed Insetti raccolti nell'Isola di Sardegna. Milano (handbill!).

*Helix lanuginosa*, ROSSMÄSSLER, 1839. Icon. Land - Suss. - Moll., **2** (3-4): 8, Pl. 43: Fig. 574. (partim).

*Helix lanuginosa*, PFEIFFER, 1847, Mon. Hel. viv., **1**: 145 (partim).

*Helix (Fruticicola, Zenobia) lanuginosa*, KOBELT, 1871 Cat. Binn.: 10.

? *Helix lanuginosa*, PAULUCCI, 1882. *Bull. Soc. malac. it.*, **8**: 356.

*Helix (Helicella, Fruticicola, Trichia) lanuginosa*, TRYON, 1887. Manual Conch. Pulmonata, (II) **3**: 180, Pl. 40: Figs. 50-51 (partim).

*Helix (Fruticicola, Trichia) lanuginosa*, WESTERLUND, 1889. *Fauna paläarct. Reg. Binn.*, **2**: 65 (partim).

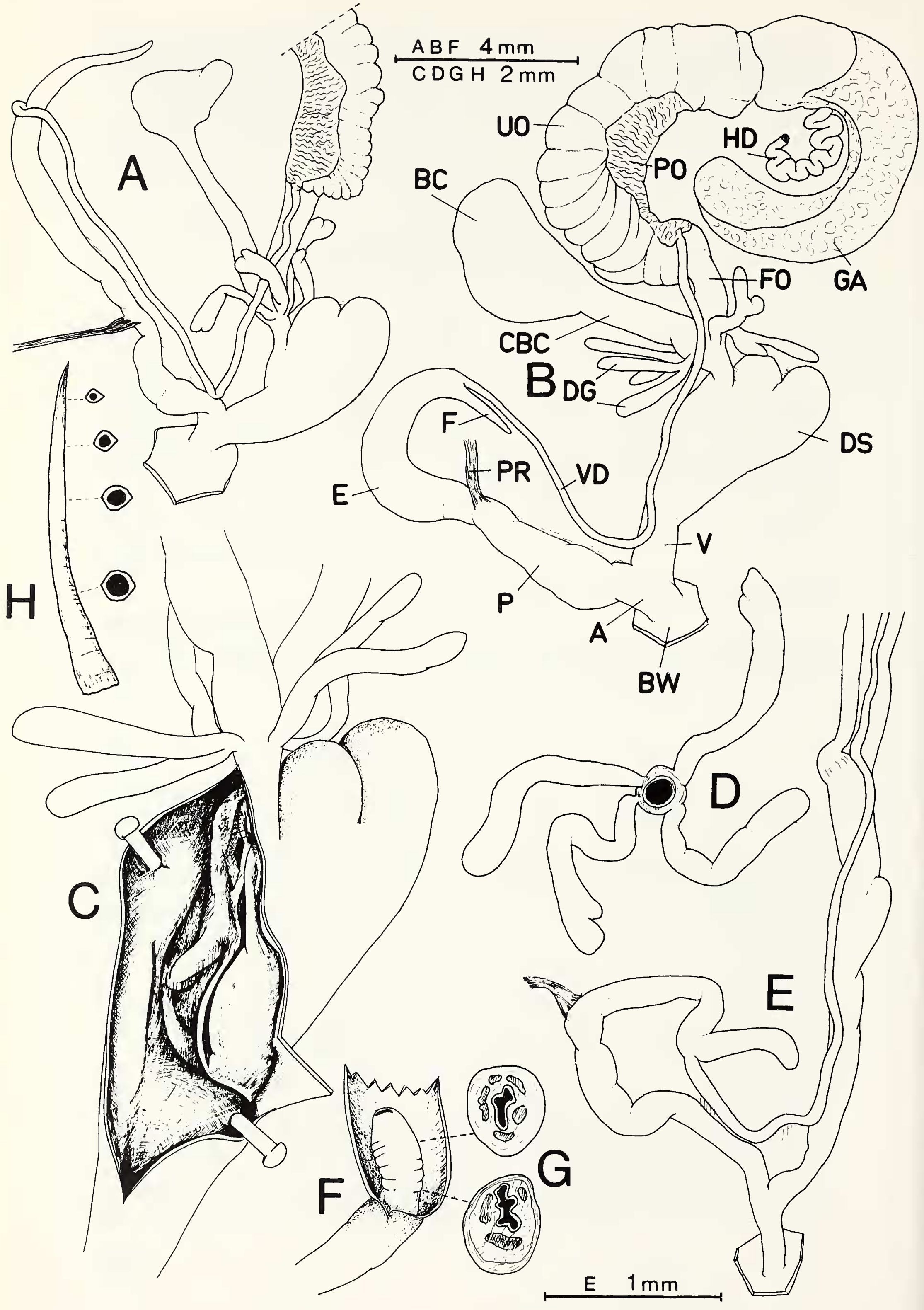
*Monacha lanuginosa*, HESSE, 1931. *Zoologica*, **81**: 14, Pl. 1: Fig. 8.

*Hygromia* (s. str.) *lanuginosa*, FORCART, 1954. *Arch. Moll.*, **83** (4/6): 159.

*Trichia lanuginosa*, GASULL, 1963. *Bol. Soc. Hist. nat. Baleares*, **9**: 23-27.

*Hygromia (Ganula) lanuginosa*, GITTENBERGER, 1970. *Bol. Soc. Hist. nat. Baleares*, **14**: 63-65, Fig. 3.

*Hygromia (Ganula) lanuginosa*, GIUSTI & CASTAGNOLO, 1983. *Lav. Soc. it. Biogeogr.*, (NS), **8**: 356.


ABF 4mm
CDGH 2mm
A
UO
PO
HD
BC
FO
GA
CBC
B
DG
F
PR
VD
DS
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V
P
A
BW
H
C
D
E
F
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E 1mm

Fig. 11

## Material examined:

**Sardinia:** 1) Arbatax, NIENHUIS leg. 12.1.1972, (1).

## Historical Notes

The name *Helix lanuginosa* and the presumed synonym *Helix flava* TERVER, 1839 was reported in Sardinia by VILLA (1836). It is not, however, absolutely certain that VILLA's specimens belonged to BOISSY's species. It is likely that VILLA gave the name *H. lanuginosa* to one of the new species which will be described in this note. This species was thus again listed among those of Sardinia by PAULUCCI (1882). More recently GIUSTI & CASTAGNOLO (1982) and GIUSTI & MANGANELLI (1984) confirmed its presence in Sardinia after anatomical examination of a specimen from Arbatax.

## Description and Comments

The live adult specimen found by Dr. J. NIENHUIS near Arbatax reached us with its shell broken into small pieces. This prevented comparison of the shell shape with the original material from Palma (Majorca). Scanning electron microscope examination of the pieces showed two kinds of periostracal microsculpture very similar to that of specimens from Palma (Pl. 10: Figs. D-F). The periostracum is provided with rows of short hairs which extend to cover all the whorls of the teleoconch. There are minute narrow regularly spaced longitudinal crests, sometimes fragmented to appear as rows of small drop-like structures. Large areas are without microsculpture suggesting its caducity.

The genital duct (Fig. 11B-C) of the Arbatax specimen is also very similar to that of the Palma specimens (Fig. 11A, D-G). The only difference consists in a somewhat shorter penial flagellum.

For the study of the radula (Pl. 14: Figs. E-H) we used a Balearic specimen for lack of Sardinian material. The many rows of teeth consist of about 65 units according to the formula 32+C+32. The central tooth has a robust basal plate with distinct pointed upper vertices and an apex having a wide pointed mesocone and two small clearly defined ectocones. The first lateral teeth also have an evident basal plate but with only the outer vertex distinct and pointed. The apex of the lateral teeth is formed by a wide robust and pointed mesocone and a short sharp robust ectocone. The mesocone often has a small protuberance on its inner side, which seems to prelude the second point of the mesocone apex of the lateromarginal and marginal teeth. Moving laterally, the teeth become progressively less massive with more slender and sharper cusps and progressively reduced basal

**Fig. 11** - *Ganula lanuginosa* (BOISSY). The genital duct and some of its portions in a specimen from Arbatax (Sardinia, NIENHUIS leg.) (B-C, H) and from Porto Cristo (Mallorca, Balearic Islands, GASULL leg.) (A, D-G). A-B: genital duct (gonad excluded); C: the vagina is opened to show the vaginal structure whose lips encircle the opening of the stylophores; D: digitiform glands; E: genital duct in a young specimen; F-G: the penial papilla and two sections at different levels (Symbols as in Fig. 1): dart and some of its transverse sections.

plate. At about 15th-23th lateral tooth the apex of the mesocone begins to show signs of doubling of the apex. The ectocone only begins to have a double apex at about 18th-20th tooth. The extreme marginal teeth are smaller, no longer with evident basal plate; the mesocone apex only occasionally has two points and the ectocone has 2-3 points.

### Zoogeographical Notes

These findings clearly confirm the presence of *G. lanuginosa* in Sardinia. This species appears to be of considerable zoogeographical interest. Its presence in the Balearic Islands and the south of Spain (Gasull, 1963; Sacchi, 1964; Giusti & Castagnolo, 1983; Giusti & Manganelli, 1984) may mean that *G. lanuginosa* is autoctonous in Sardinia and that it was part of the ancient fauna of the Sardo-Corsican complex before it broke away from the south-west flank of the European continent (Giusti & Manganelli, 1984).

## Genus *Ichnusotricha* n.

### Description

The shell is small to medium in size, globular or moderately depressed, of varying shades of yellow-brown with a conical spire formed by $4^3/_4$ - $5^3/_4$ whorls which increase gradually and regularly. The last whorl is slightly angled at its periphery. The umbilicus is very small and almost entirely covered by the reflexed columellar margin of the peristome. The peristome is not thickened and usually reflexed only at the columellar margin, but very occasionally there is slight reflexing of its entire lenght. The external surface of the periostracal layer of the teleoconch has two types of microsculpture: fairly regular transverse rows of short hairs; minute narrow more or less regularly spaced longitudinal crests which are often interrupted or fragmented into rows of small drop-like structures.

The genital duct is characterized by a long wide proximal vagina, two stylophores lying side by side giving rise to a proportionately underdeveloped complex in the distal half of the vagina; the inner is somewhat smaller than the outer stylophore; the dart cavity of the two stylophores open independently into the groove of a large and long vaginal structure, the pointed apex of which extends as far as the genital atrium; only one slightly arched dart of elliptical transverse section in the outer stylophore; digitiform glands present; bursa copulatrix duct no longer than the vagina with a widened initial portion; penis as long as the epiphallus; long penial papilla (glans) with an apical opening, showing, in transverse section, a central canal and wide walls in which some lacunae are visible; short penial flagellum. The r.o. retractor passes between penis and vagina.

## Derivatio nominis

The name *Ichnusotricha* (from Greek words: Ἰχνοῦσσα, ῆς ; Latinized: Ichnusa (in Plinio) = Sardinia and θρῖξ, g. τριχός ; Latinized: thrix-trichós = hair) indicates the similarity of the new taxon, very common in Sardinia, to other genera having hairly shell.

## Comments

The presence of a particularly long vagina, two small stylophores and an enormous grooved structure inserted in the vagina, clearly differentiate *Ichnusotricha* from many European and Western European genera: *Hygromia, Lozekia, Pyrenaearia, Ganula, Zenobiella, Lozekia.* The appearance of the vagina and annexed structures is similar to several Eastern European genera such as *Fruticocampylea, Schileykoia* and *Circassina.*

*Fruticocampylea* (Schileyko, 1972a: 1133, Fig. 3; 1978b: 242-243, Figs. 277-282) is distinguished by its extremely short proximal vagina, two longer stylophores ending in the vagina after converging into a single conical apex, i.e. there is not grooved vaginal structure.

*Schileykoia* (Schileyko, 1972a: 1133, Fig. 4; 1978b: 245, Figs. 283-287) is distinguished by its very short proximal vagina, two well developed stylophores converging into the same opening inside the groove of a wide vaginal structure.

*Circassina* with its type-species *C. circassica circassica* (Schileyko, 1972a: 1133, Fig. 5; 1978b: 246, Figs. 288-290) is distinguished by two stylophores which converge into a unique conical structure.

By the above described anatomical characteristics, the new genus belongs in the subfamily Hygromiinae and, as far as is currently known, is limitated to the island of Sardinia and southern Corsica.

**Type-species:**

## *Ichnusotricha berninii* n. sp.

(Figs. 12-13; Fig. 16D; Pl. 5: Figs. A-H; Pl. 10: Figs. A-C; Pl. 12: Fig. H; Pl. 15: Figs. D-F).

*Helix perlevis*, Shuttleworth, 1852. *Mitt. naturf. Ges. Bern*, **260-261:** 295 (partim, non Shuttleworth, 1852).

*Helix (Fruticicola) perlevis*, Albers, 1860. Heliceen Verwandt.: 104 (partim, non Shuttleworth, 1852).

*Helix (Fruticicola, Zenobia) perlevis*, Kobelt, 1871. Cat. Binn.: 10 (partim, non Shuttleworth, 1852).

*Helix (Trichia) perlevis*, Paulucci, 1878. Mat. Faune malac. It.: 3 (non Shuttleworth, 1852).

*Helix (Arichia)* (sic!) *perlevis*, Paulucci, 1882. *Bull. Soc. malac. it.*, **8:** 202, Pl. 3: Figs. 4-4a-4b (partim, non Shuttleworth, 1852).

*Helix (Arichia)* (sic!) *Corsica*, Paulucci, 1882. *Bul. Soc. malac. it.*, **8:** 200-201 (partim, non Shuttleworth, 1843).

*Helix (Helicella, Fruticicola, Trichia) perlevis*, Tryon, 1887. Manual Conch. Pulmonata, (II) **3:** 181-182, Pl. 41: Figs. 92-94 (partim, non Shuttleworth, 1852).

*Helix (Fruticicola, Trichia) perlevis*, WESTERLUND, 1889. *Fauna paläarct. Reg. Binn.*, **2:** 64 (partim, non SHUTTLEWORTH, 1852).

*Helix (Trichia) corsica*, KOBELT, 1890. Icon. Land-Suss.-Moll., (N.F.), **5:** 4-5 (partim, non SHUTTLEWORTH, 1843).

*Helix (Trichia) perlevis*, KOBELT, 1890. Icon. Land. Suss.-Moll., (N.F.), **5:** 5, Pl. 121: Fig. 725 (partim, non SHUTTLEWORTH, 1852).

*Hygromia (Trichia) perlevis*, PILSBRY, 1895. Manual Conch. Pulmonata, (II) **9:** 274 (partim, non SHUTTLEWORTH 1852).

*Helix (Zenobia) Perlevis*, CAZIOT, 1902. *Bull. Soc. Sci. hist. nat. Corse*, 95-96 (partim, non SHUTTLEWORTH, 1852).

*? Theba corsica*, HESSE, 1927. *Arch. Moll.*, **59** (3): 175 (non SHUTTLEWORTH, 1843).

*? Theba perlevis*, HESSE, 1927. *Arch. Moll.*, **59** (3): 175 (non SHUTTLEWORTH 1852).

*Theba (Cyrnotheba) corsica*, GERMAIN, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 282-283 (partim, non SHUTTLEWORTH, 1843).

*Theba (Cyrnotheba) perlevis*, GERMAIN, 1929. *Arch. Mus. Hist. nat. Lyon*, **13:** 283-284 (partim, non SHUTTLEWORTH, 1852).

*Theba (Cyrnotheba) perlevis*, GERMAIN, 1930. Faune France, **21:** 268-269 (partim, non SHUTTLEWORTH, 1852).

*Trichia sp.*, ZULLINI, PARISI & MICHELANGELI, 1968. *Rend. Ac. naz.* XL, (IV) **18:** 6.

*Theba (Cyrnotheba) corsica*, ALZONA, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat.* Milano, **111:** 184 (partim, non SHUTTLEWORTH, 1843).

*Theba (Cyrnotheba) perlevis*, ALZONA, 1971. *Atti Soc. it. Sci. nat. Museo civ. St. nat.* Milano, **111:** 184 (partim, non SHUTTLEWORTH, 1852).

*Monacha perlevis*, HOLYOAK, 1983. *J. Conch. London*, **31:** 246-247 (partim, non SHUTTLEWORTH, 1852).

*N. gen., n. sp.*, GIUSTI & CASTAGNOLO, 1983. *Lav. Soc. it. Biogeogr.*, (NS), **8:** 235.

## Description

The shell (Pl. 5: Figs. A-H) is of small to medium size, globular or sometimes slightly flattened and variable shades of yellow-brown. The spire is conical of variable elevation and has 4$^3/_4$-5$^3/_4$ slowly and regularly increasing whorls, the last of which is angled to a variable degree. The whorl surface is convex, sometimes almost flat, with moderately deep sutures. The umbilicus is very small and almost completely covered by the reflexed columellar margin of the peristome. The opening is oval and oblique. The peristome is not thickened, and if reflexed, only slightly. The external surface of the protoconch (Pl. 10: Fig. A) is finely wrinkled and marked with minute longitudinal grooves. The external surface of the teleoconch (Pl. 10: Figs. B-C) has fairly regular transverse rows of short hairs and minute more or less regularly spaced longitudinal crests which are often interrupted and fragmented into rows of small drop-like structures.

Dimensions: max. diam. = 10-11 mm; h. = 6.8-9.5 mm.

The genital duct (Figs. 12-13; 16D) has a multilobate gonad from which the first hermaphrodite duct arises. The duct is circumvoluted and, in adult specimens, filled with spermatozoa. It ends in the «talon» (i.e. fecundation chamber + seminal receptacles complex) which lies on the inner side of a large albumen gland near the beginning of the second hermaphrodite duct (or ovispermiduct) which consists of a prostatic and a

**Fig. 12** - *Ichnusotricha berninii* n. sp. The genital duct (gonad excluded) in specimens from: Monte Scopeto near Bonifacio (Corsica) (A), Monte Pilai near Bonorva (Sardinia) (B), Monte Nieddu near Nuxis (Sardinia) (C), Park of the Marquis of Laconi (Sardinia) (D) (Symbols as in Fig. 1).

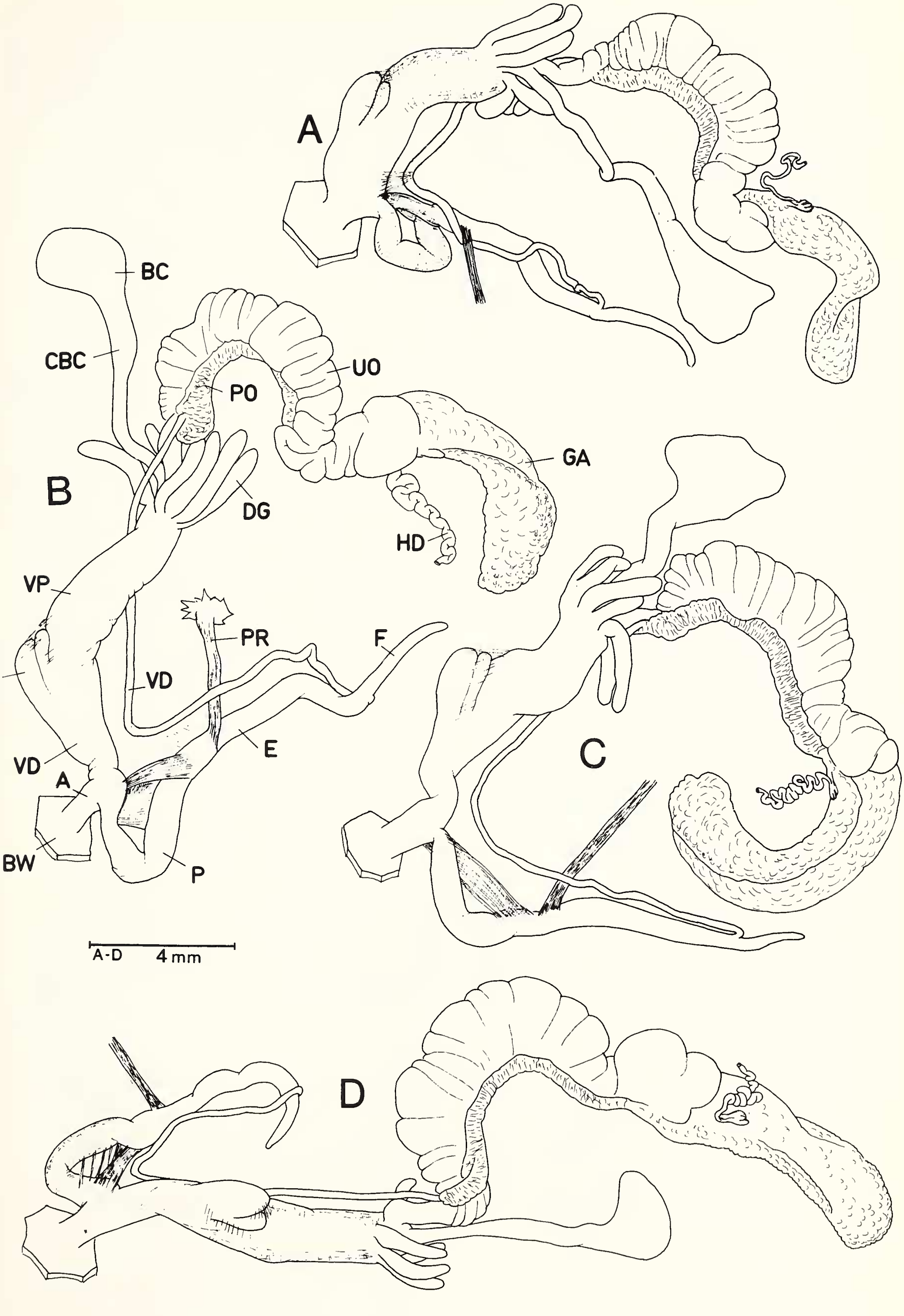

Fig. 12

uterine portion. A long slender vas deferens originates from the anterior portion and ends in the base of the penial complex. The latter consists of a short flagellum (1 = 2.3-4.8 mm), an epiphallus (i.e. that part extending from where the vas deferens ends to the point of attachment of the penial retractor) and a penis (i.e. that part extending from where the penial retractor ends to the genital atrium). The penial retractor is short and fairly wide. The penis is often twisted back upon itself by virtue of a muscolar-connective sheath joining the walls of the proximal to the distal portion which immediately preceeds the genital atrium. There is a long penial papilla (glans) inside the distal portion of the penis. Its opening is apical and in transverse section it shows a central laterally compressed canal and very thick walls with very few lacunae.

The uterine portion of the ovispermiduct continues anteriorly into a short slender uterine canal (free oviduct). A slender duct arises in its walls and leads to an irregularly shaped bursa copulatrix (i.e. gametolytic gland) of variable width. Seven or eight digitiform glands are regularly disposed around the sides of the initial portion of the proximal vagina. The vagina is very long and wide and consists of a proximal (from the digitiform glands to behind the stylophores) and a distal portion to which two small slender stylophores are annexed. These are ensheathed in a bundle of tissue adhering to the vaginal wall. The outer is somewhat larger than the inner stylophore and its internal cavity is provided with a small gently arched dart of elliptical transverse section. The inner cavities of the two stylophores end in two independent openings inside the groove of a long tongue-like structure which is as long as the entire vagina. Near the genital atrium the two lateral sides of the tongue-like structure fuse to form an empty cone, open at its tip. Penis and vagina converge in the genital atrium which opens on the right, near the animal's head.

The radula (Pl. 15: Figs. D-E) consists of many rows of 63-73 teeth according to the formula 31–36+C+31–36. The central tooth has a wide basal plate with distinct pointed upper vertices. The apex of the tooth has a large robust mesocone and two tiny short ectocones. The first lateral teeth also have a robust basal plate but with only one (the outermost) distinct pointed vertex. The apex of the lateral teeth is formed by a wide strong mesocone and a small ectocone. The mesocone often has a slight indentation on its inner side which seems to prelude the double point of the apex of the mesocone of the latero-marginal and marginal teeth. Moving laterally, the teeth maintain their appearance but become gradually less massive, with more slender pointed cusps and progressively reduced basal plate. At about 18th-25th tooth the mesocone and ectocone apices

**Fig. 13** - *Ichnusotricha berninii* n. sp. Some portions of the genital duct in specimens from Monte Scopeto near Bonifacio (Corsica) (A-B); Monte Pilai near Bonorva (Sardinia) (C); Island of Tavolara (Sardinia) (D-E); Monte Settefratelli (Sarrabus, Sardinia) (F); near Sassari (Sardinia) (G-H); near Dorgali (Sardinia) (L). A-B: the everted last portion of the genital duct. In B the position of the two stylophores is indicated; C: the vagina is opened to show the long vaginal structure, in the groove of which the openings of the two stylophores are indicated; D: dart and its transverse section; E: digitiform glands; F-H: penial papilla and its transverse section; L: last portion of the genital duct in a young specimen (Symbols as in Fig. 1).

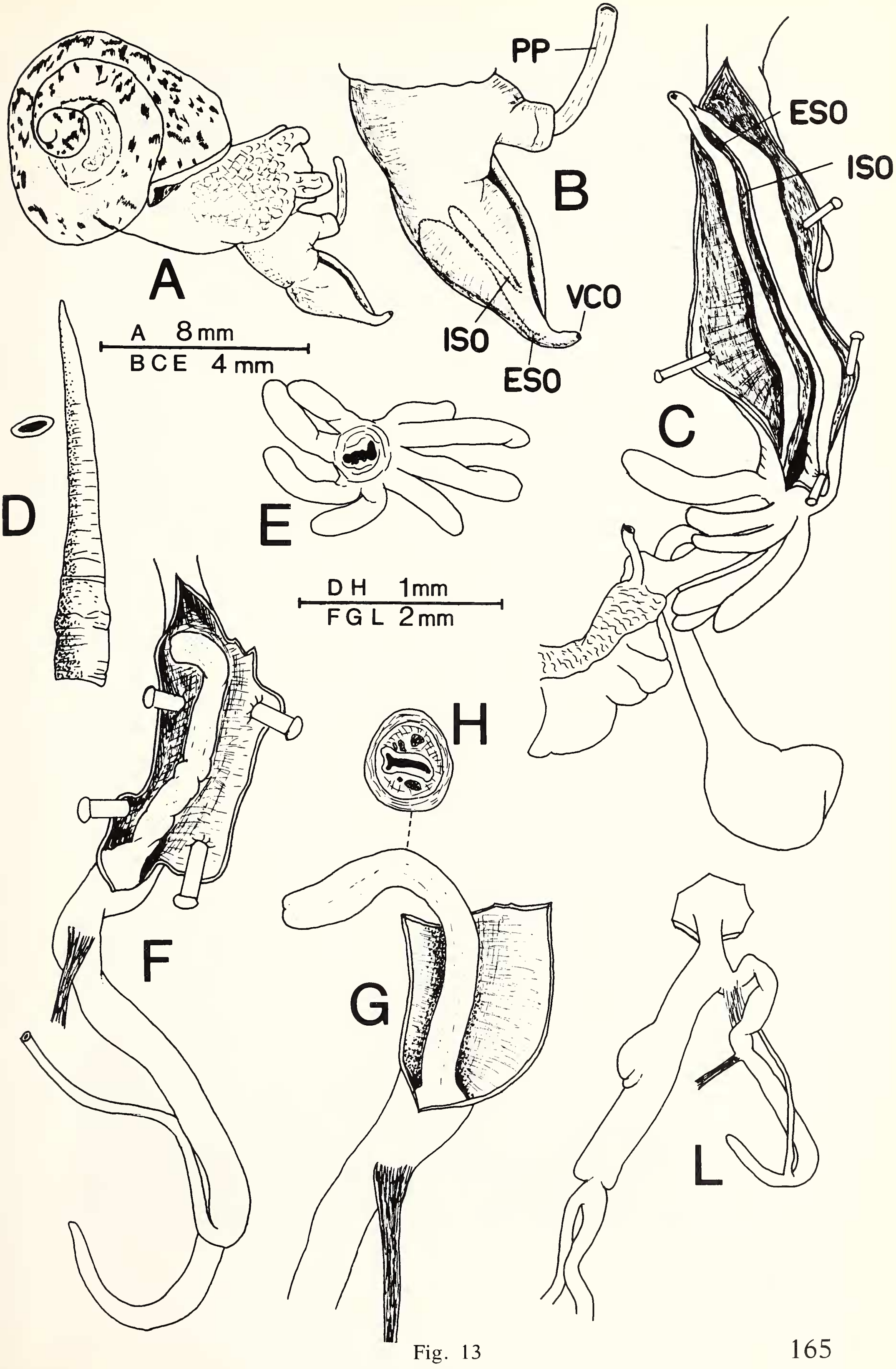

Fig. 13

begin to have two points. The extreme marginal teeth have a sharp slender shortish mesocone with a double apex and an ectocone with 2-3 small slender points.

The animal's body is pinkish in colour and an upper palleal wall with randomly arranged irregular black spots.

## Derivatio nominis

The new species is dedicated to our colleague and friend Prof. FABIO BERNINI.

**Locus typicus:** Laconi (CA), Sardinia

## Typical series:

***Holotypus*** (Pl. 5: Fig. A): Laconi, Park of the Marquis of Laconi, 25.4.1985, GIUSTI Coll. (shell).

***Paratypi*:** 6 alcohol sp. (3 of these without shell), Laconi, Park of the Marquis of Laconi, 25.4.1985, GIUSTI Coll.; 18 shells, Laconi, Park of the Marquis of Laconi, 2.5.1975, 25.4.1985, GIUSTI Coll.; 9 shells, Laconi, Park of the Marquis of Laconi, CAROTI leg. 5.1879, PAULUCCI (1882) det. *H. perlevis*, PAULUCCI Coll. MZUF 4610; 7 shells, calcareous rocks near Laconi, CAROTI leg. 5.1879, PAULUCCI (1882) det. *H. perlevis*, PAULUCCI Coll., MZUF 4611.

## Other material examined:

**Corsica:** 1) Bonifacio, ancien chemin de Sartene, HAGENMULLER leg. (1) BOURGUIGNAT det. *H. acvarica* (sic!) (non LOCARD 1893); 2) near Bonifacio, loc. Chiosa d'Asino, 30.11.1983 (5); 3) near Bonifacio, loc. Monte Scopeto, 1.12.1983 (n).

**Sardinia:** 1) Argentiera, 29.3.1977 (1); 2) near Aritzo, 800 m, 5.1935 (3) det. *F. perlevis.* PFEIFFER Coll. SMF 98787; 3) near Ballao, 29.3.1977 (1); 4) Baunei, 600 m, 5.1935, (1) det. *F. perlevis.* PFEIFFER Coll., SMF 98783; 5) Baunei, 4.4.1978 (3); 6) near Bonorva, loc. Monte Pilai, 30.3.1977 (2); 7) Cala Gonone, PINTER leg. 2.7.1981 (2); 8) Capo Caccia, 29.3.1977 (5); PINTER leg. 5.7.1981 (n); 9) Capo Figari, 23.4.1985 (n); 10) Capo Sant'Elia, CAROTI leg. 1879, (1) PAULUCCI 1882 det. *H. corsica.* PAULUCCI Coll., MZUF 4612; 11) near Desulo, 1.4.1978 (4); 12) near Dorgali, 26.4.1985 (5); 13) near Dorgali, loc. Monte Bardia, PINTER leg. (2); 14) near Dorgali, loc. Su Gologone, PINTER leg. 29.3.1978 (2); 15) between Fonni and Mamoiada, 1.4.1978 (5); 16) near Guspini, loc. Montevecchio, 20.3.1976 (5); 17) near Guspini, loc. Su Ingurtosu, 20.3.1976 (2); 18) island of Budelli, 26.9.1985 (2); 19) island of Caprera, loc. Telaione, 25.9.1985 (2); 20) island of La Maddalena, Baia della Trinità, 24.9.1985 (n); 21) island of Molara, 28.9.1985 (3); 22) island of Santa Maria, 26.9.1985 (6); 23) island of Spargi 25.9.1985 (9); 24) island of Tavolara, 27.8.1985 (2); 25) island of Tavolara, COBOLLI & VIGNA leg. 27.8.1985 (5); 26) Laconi, Park of the Marquis of Laconi, 5.1935 (2) det. *F. perlevis.* PFEIFFER Coll., SMF 98786; 27) Laconi, calcareous rocks near Laconi, CAROTI leg. 5.1879, (2) PAULUCCI (1882) det. *H. perlevis.* PAULUCCI Coll., MZUF 4613; 28) near Laconi, 1.4.1978, 25.4.1985 (n); PINTER leg. 30.6.1981 (n); 29) Laconi, Park of the Marquis of Laconi, 2.5.1975, 25.4.1985 (n); PINTER leg. 30.6.1981, 22.7.1981, 2.8.1981 (n); 30) Lago Santo, 27.3.1977 (1); 31) Monte Albo, 950 m, 6.1935, (6), det. *F. perlevis.* PFEIFFER Coll., SMF 98782; 32) slopes of Monte Limbara, 28.3.1977 (4); 33) Monte Santo di Pula, CAROTI leg. 1879, (6) PAULUCCI (1882) det. *H. perlevis.* PAULUCCI Coll., MZUF 4614; 34) near Nurallao, PINTER leg. 30.6.1981 (6); 35) Nuxis, slopes of Monte Nieddu, 23.3.1976 (n); 36) between Olbia and Golfo di Arzachena, 1.5.1969 (1); 37) Ogliastra, Gola di San Giorgio, CAROTI leg. 5.1879, (9), PAULUCCI (1882) det. *H. corsica.* PAULUCCI Coll., MZUF 4615; 38) Ogliastra, Gola di San Giorgio, NIENHUIS leg. 25.1.1972 (1); 39) Ozieri, 26.3.1976, 23.4.1985 (n); 40) Perdasdefogu, slopes of Monte Cardiga, PUDDU leg. 23.5.1973; 41) Perdaxius, 22.3.1976; 42) between San Basilio and Lago Mulargia, 2.4.1978 (2); 43) San Pasquale in Gallura, 26.3.1977, (7); 44) San Teresa in Gallura, 26.3.1977, (1); 45) Sant'Antonio Ruinas, (1) det. *M. (C.) perlevis.* BOETTGER Coll., SMF 69129; 46) Sardinia, BLAUNER leg. (3) SHUTTLEWORTH (1852) det. *H. perlevis.* SHUTTLEWORTH Coll., NMB 716; 47)

Sarrabus, loc. Monte Settefratelli, 3.4.1978 (6); 48) Sassari, ROLLE leg. 1886, (1) det. *H. perlevis.* Ex. STURANY Coll., NMW 19898 32r8; 49) near Sassari, 22.6.1977, (2); 50) Sa Tela, (1) det. *M. (C.) perlevis.* BOETTGER Coll., SMF 69126; 51) Supramonte di Oliena, 3.5.1975, (5); PINTER leg. 3.7.1981, (1); 52) Tacquisara Valley, CAROTI leg. 1879, (4) PAULUCCI (1882) det. *H. corsica.* PAULUCCI Coll., MZUF 4616; 53) Tacquisara Valley, 900 m, 5.1935, (1) det. *M. (C.) perlevis.* PFEIFFER Coll., SMF 98784; 54) near Tertenia, loc. Ponte Corongiu, 4.4.1978, (4); 55) Ulassai, 850 m, 5.1935, (1) det. *M. (C.) perlevis.* PFEIFFER Coll., SMF 98785; 56) Ulassai, 4.4.1978, (4); PINTER leg. 1.7.1981, (2).

### Comments and Zoogeographical Notes

As mentioned in the discussion of the genus *Ichnusotricha, I. berninii* is endemic in the Sardo-Corsican complex and so clearly characterized anatomically as not to be confused with any other entity known at present.

It can be found everywhere in Sardinia and even extends to the southern part of Corsica. This seems to testify to its Sardinian origin and only recent arrival in Corsica, perhaps passively transported by man. It is possible, however, that the species reached Corsica autonomously in one of the Pleistocenic phases of marine regression when Sardinia and Corsica where joined via La Maddalena Archipelago (JEANNEL, 1961; GIUSTI, 1977; GIUSTI & CASTAGNOLO, 1983). This theory is also supported by the presence only in southern Corsica of other Sardinian entities unlikely to have been transported passively by man, namely *Testacella gestroi* ISSEL.

As is clear from our list of synonyms, the species was known to authors in the past. However it was erroneously interpreted and given the inappropriate names of the Corsican species «*Helix*» *perlevis* and «*Helix*» *corsica*.

## Genus *Nienhuisiella* n.

### Description

The shell is small to medium in size, lenticular, slightly flat, yellow or light brown with a conical spire of 4$^1/_2$-5 slowly and regularly increasing whorls. The periphery of the last whorl is variably angled. The umbilicus is small and partially covered by the reflexed columellar margin of the peristome. Peristome not thickened and slightly reflexed only at its lower margin.

The external surface of the periostracal layer of the teleoconch has two types of microsculpture: transverse rows of long hairs and minute narrow more or less regularly spaced longitudinal crests, often interrupted or fragmented into rows of small drop-like structures.

The genital duct is characterized by a vagina of medium lenght and width without of stylophores; a small oval evagination on one side of the vagina in the vicinity of the digitiform glands may constitute a residue of a dart-sac complex; the bursa copulatrix duct as long as or slightly longer than the vagina with a slender initial portion; digitiform glands forming four tufts, each divided into two branches; penis and epiphallus of equal lenght; penial papilla (glans) of medium lenght with an apical opening and, in transverse section, thick walls with some lacunae and a unique central canal; very long penial flagellum. The r.o. retractor passes between penis and vagina.

## Derivatio nominis

The new genus is dedicated to our colleague Dr. Jos Nienhuis of Woltersum (Holland) who has performed many malacological studies in Sardinia and given us all his material.

## Comments

The complete absence of traces of stylophores in the vaginal part of the genital apparatus distinguishes *Nienhuisiella* from the genus *Ichnusotricha* previously described. Both are found in Sardinia and have a hairy shell. The same features distinguish the new genus from most of the other European genera of the Hygromiinae such as: *Hygromia, Ganula, Zenobiella* and *Pyrenaearia*. The presence of digitiform glands and other anatomical and shell features distinguishes it from the genus *Cyrnotheba*, the type-specie *C. corsica* of which, is also without stylophores.

Of the group characterised by digitiform glands but without stylophores the closest seem to be the genera *Metatheba* and *Montserratina* and a poorly defined taxon *«Circassina circassica» stephaniae* (Hudec & Lezhawa) (sensu Schileyko, 1972a, 1978b).

*Metatheba* is certainly different. Apart from other features such as the structure of the penial papilla, the r.o. retractor muscle does not pass between penis and vagina exactly as in the genus *Monacha* (subfam. Euomphaliinae sensu Schileyko, 1978b).

*Montserratina* is more similar. It was proposed by Ortiz De Zarate y Lopez (1946) for a Spanish hairy shell species: *Helix bofilliana* Fagot. However, its digitiform glands are regressive and consist of only two single units, one of which is sometimes divided into two branches. The penial flagellum is shorter and the bursa copulatrix (gametolytic gland) has a peculiar shoe-like form with a foreward extending portion. These characters may not seem sufficiently important for distinguishing genera, however, until we have more exact and detailed anatomical and shell analysis of Fagot's species, they enable the Sardinian species to be distinguished in the new genus *Nienhuisiella*, thus preventing inappropriate associations.

Apart from its uncertain status, *«Circassina circassica» stephaniae* seems to be distinguished by the shortness of the vagina, the digitiform glands arranged in two tufts arising from opposite sides of the vagina and the penial papilla of completely different structure in transverse section (Schileyko, 1972a, 1978b).

We think it is opportune to anticipate the possibility that someone may hypothesize a relationship between the genera *Ichnusotricha* and *Nienhuisiella*, owing to the external shell microsculpture and certain anatomical similarities. It may be supposed that the genus *Nienhuisiella* originated from *Ichnusotricha* with the disappearance of the latter's dart sacs, the consequent reduction in size of the vagina and the disappearance of certain internal vaginally annexed structures (namely, the grooved tongue-like structure). This is certainly plausible if we consider the close geographical contiguity of the two genera, but it does not make the new genus any less valid. Schileyko's (1972a, 1978b) affirmation that three anatomically quite different forms belong to a single genus (*Circassina*) and the same species (*C. circassica*) because of presumed progressive reduction of vaginally annexed structures, seems without sufficient grounds and needful of closer study.

If SCHILEYKO (1972a, 1978b) is right, *Ichnusotricha* and *Nienhuisiella* could obviously form sections of the same generic taxon. In this case it would be necessary to completely reconsider the significance of the presence or absence of many parts of the genital apparatus, leaving the classification of not only the Helicoidea in a state of great uncertainty. It seems necessary now for SCHILEYKO to demonstrate the validity of his propositions about the subspecies of *Circassina circassica* using genetic techniques or simple interbreeding experiments.

**Type-species:**

## *Nienhuisiella antonellae* n. sp.

(Figs. 14-15; Pl. 6: Figs. A-E; Pl. 11: Figs. A-D; Pl. 15: Figs. A-C).

*Monacha (Cyrnotheba) corsica*, PUDDU & PIRODDA, 1974. *Rend. Seminario Fac. Univ. Cagliari*, **43:** 156 (non SHUTTLEWORTH, 1843).

*N. gen., n. sp.*, GIUSTI & CASTAGNOLO, 1983. *Lav. Soc. it. Biogeogr.*, (NS), **8:** 235.

### Description

The shell (Pl. 6: Figs. A-E) is small to medium in size, lenticular, slightly flattened, yellow to light brown in colour with a conical spire formed of $4^1/_2$-5 slowly and regularly increasing whorls, with the last whorl variably angled at its periphery. The surface of the whorls is convex, the sutures are moderately deep and the umbilicus small, partially covered by the reflexed columellar margin of the peristome. The mouth is oval in shape and oblique; the external and superior margins of the peristome are not thickened and slightly or not reflexed.

The external surface of the protoconch (Pl. 11: Fig. A) is slightly wrinkled and marked by a few minute spiral grooves. The external surface of the teleoconch (Pl. 11: Figs. B-D) has transverse rows of long caducous hairs which leave clear basal prints once they have fallen. The periostracal surface is marked by minute more or less regularly spaced longitudinal crests which are often interrupted or fragmented into rows of small drop-like structures.

Dimensions: max diam. = 9-11.5 mm, h. = 6-7.2 mm.

The genital duct (Figs. 14-15) has a plurilobate hermaphrodite gonad from which arises the first hermaphrodite duct which is convoluted and, in adult specimens, filled with spermatozoa. This duct ends in the talon (or fecundation chamber + seminal receptacles complex) which lies on the inner side of a well developed albumen gland, just near the beginning of the second hermaphrodite duct (i.e. ovispermiduct). The latter is wide and plurilobate and consists of prostatic and uterine portions. The former continues anteriorly into a long slender vas deferens ending in the penial complex which consists of a long (14-15 mm) penial flagellum, an epiphallus (i.e. that part extending from where the vas deferens ends to the point of attachment of the penial retractor) and a penis (i.e. that part extending from where the penial retractor ends to the genital atrium). The penial retractor is fairly long and slender. The penis is often twisted on itself by virtue of a muscolar sheath connecting the distal epiphallus and proximal penis walls with the walls of the distal penis. Inside the penis there is a fairly large penial papilla (i.e. glans) with an apical opening, whose transverse sections reveal thick walls containing a ring of small lacunae which encircle a central laterally compressed canal (the spermiduct). The uterine portion of the ovispermiduct continues anteriorly into a wide uterine canal (i.e. free oviduct) which ends in the vagina at the point of entry of the duct of the bursa copulatrix (i.e. gametolytic gland) which is wide and roundish. Four bifurcate digitiform glands are situated at the beginning of the vagina, three grouped together on one side and one on the other. There are no stylophores in the vagina which is moderately long and wide and ends, with the penis, in the common genital atrium. Nevertheless a small oval evagination located on the vagina in the vicinity of the digitiform glands (Fig. 15E) can be interpreted as a residue of a dart-sac complex. This structure opens into the vagina and has a series of pleats on its inner walls (Fig. 15C)..

The radula (Pl. 15: Figs. A-C) consists of many rows each of 57-65 teeth according to the formula 28–32+C+28–32. The central tooth has a wide basal plate whose upper vertices are distinct and pointed. The body of the tooth shows an apex provided with a strong mesocone and two very small ectocones. The first lateral teeth also have a wide basal plate, but the inner vertex is missing. Its apex has a strong pointed mesocone and a small pointed ectocone. Sometimes the inner side of the mesocone has a very small protuberance which seems to prelude the second point of the mesocone apex of the marginal teeth. Moving laterally, the teeth maintain the same shape but because progressively smaller with more slender pointed cusps and reduced basal plates. At 16th-26th tooth, the splitting of the mesocone apex into two points becomes more and more evident and the same happens for the ectocone apex at 23rd-27th tooth. The extreme marginal teeth are very small and their mesocone is slender with two points.

The animal's body is pale orange in colour and the upper wall of the palleal cavity has many irregularly shaped black spots.

## Derivatio nominis

The new species is dedicated to Mrs. Antonella Daviddi in gratitude for her precious contribution to our research.

**Locus typicus:** outside San Giovanni Cave, near Domusnovas (CA), Sardinia.

**Fig. 14** - *Nienhuisiella antonellae* n. sp. Genital duct (gonad excluded) in specimens from outside San Giovanni's Cave near Domusnovas (Sardinia) (A-B) and Fonni (Sardinia, Nienhuis leg.). (Symbols as in Fig. 1).

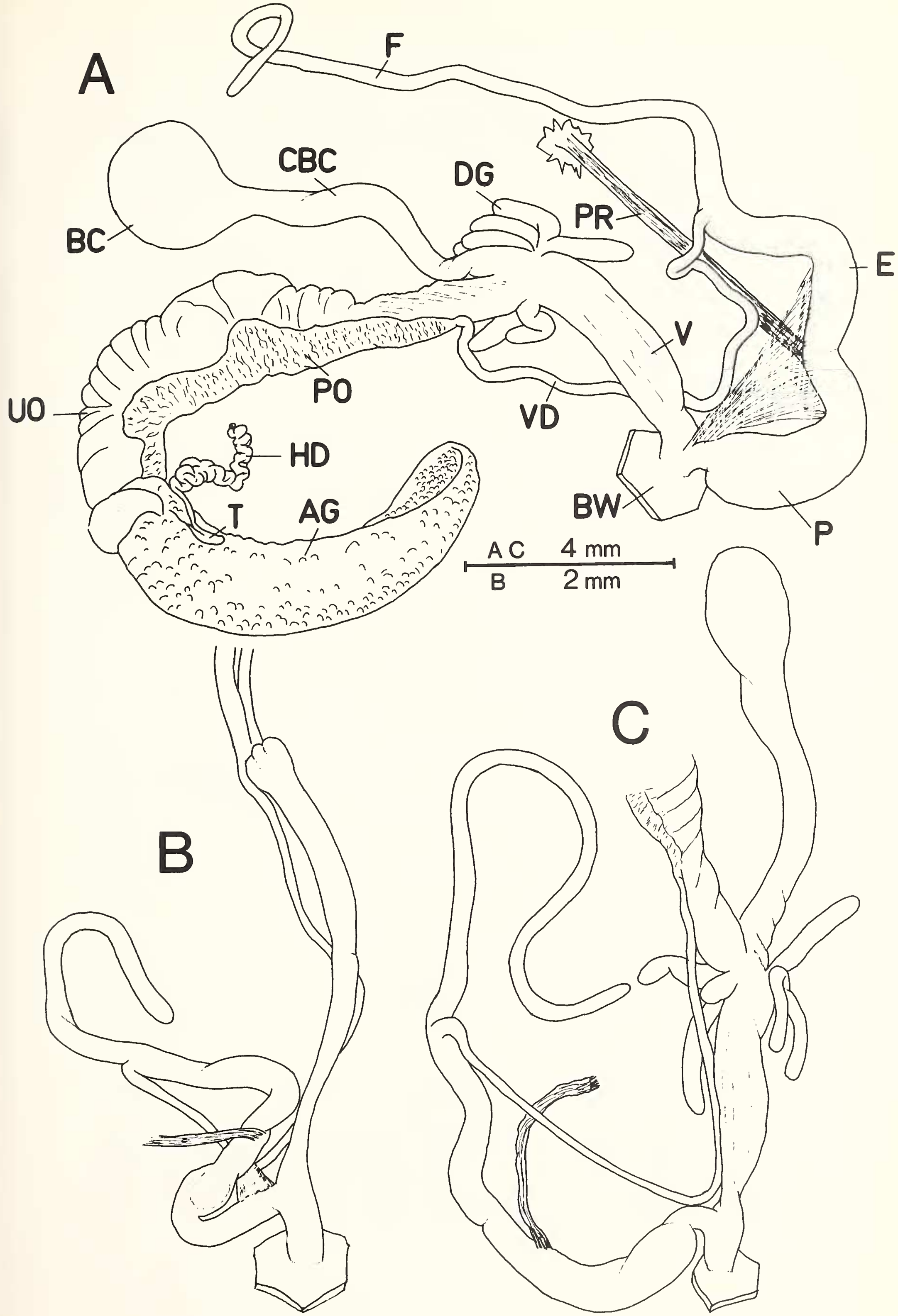

Fig. 14

## Typical series:

**Holotypus** (Pl. 6: Fig. A): outside San Giovanni's Cave, near Domusnovas, 21.3.1976, Giusti Coll. (shell).

**Paratypi:** 8 alcohol sp., outside San Giovanni's Cave, near Domusnovas, 21.3.1976, 24.4.1985; 11 shells, outside San Giovanni's Cave, near Domusnovas, 21.3.1976, 24.4.1985.

## Other material examined:

**Sardinia:** 1) near Domusnovas, outside of San Giovanni Cave, 21.3.1976, 24.4.1985, (4); Pinter leg. 29.8.1981, (5); 2) near Fluminimaggiore, outside of Su Mannau Cave, 27.10.1974, (1); Nienhuis leg. 16.1.1972, (n); 3) between Fluminimaggiore and Iglesias, 26.3.1976, (3); 4) near Fonni, Nienhuis leg. 6.1.1972, (2); 5) Iglesias, Fra Piero leg. 6.1901, (4) det. *F. corsica* var. *cattancoi (nomen in schedula)*, SMF 98771; 6) near Iglesias, loc. Corongiu de Mari, Puddu leg. 29.11.1970, (1); 7) near Siddi, loc. Prauni Strinctu, Puddu leg. 15.5.1978, (3).

## Comments

As mentioned in the discussion of the new genus *Nienhuisiella, N. antonellae* is very well characterized and distinct from every other species of the same subfamily. It is only apparently similar to *Montserratina bofilliana* (Fagot) (see Ortiz de Zarate y Lopez, 1946), a Spanish species which is distinguished by the following characters: only two tufts of digitiform glands, each simple or split into two branches: shoe-shaped anteriorly extending bursa copulatrix; a shorter penial flagellum.

The new species is endemic to Sardinia and only once cited in literature under an inappropriate name.

## Species incertae sedis

1) *Helix hispida* Caziot (1902, non Linnaeus, 1758).

Issel (1873: 2, note 2) reports a form similar to *Helix hispida* Linnaeus in Sardinia. Our investigations on the island are sufficiently extensive to permit us to negate the presence of any *Trichia* (or similar genera, such as *Perforatella*) in Sardinia.

Romagnoli fide Moquin-Tandon (1855) reports «*Helix hispida*» in the Bonifacio area in Corsica. Caziot (1902), denies its presence in Corsica but records it in Sardinia.

We also feel qualified in this case to deny that Moquin-Tandon's *H. hispida* was a true *Trichia*. The typically Mediterranean environment of the Bonifacio area seems completely unsuited to species of this genus. One of the newly described entities (*I. berninii*) is present at Bonifacio and in the rest of southern Corsica, and, having a hairy shell, may have been taken to be *H. hispida*.

However, the presence of several shells of a species of *Trichia* or *Perforatella* in the Collection of the Natur Museum Senckenberg (SMF 69119 and

**Fig. 15** - *Nienhuisiella antonellae* n. sp. Some portions of the genital duct in specimens from outside of San Giovanni's Cave near Domusnovas (Sardinia). A-B: the penial papilla and two of its transverse sections; C: the vagina is opened to show its inner structure; D: digitiform glands; E: the last portion of the genital duct is everted (Symbols as in Fig. 1). The arrows in C and E indicate the internal and external view of the oval evagination of the vagina respectively.

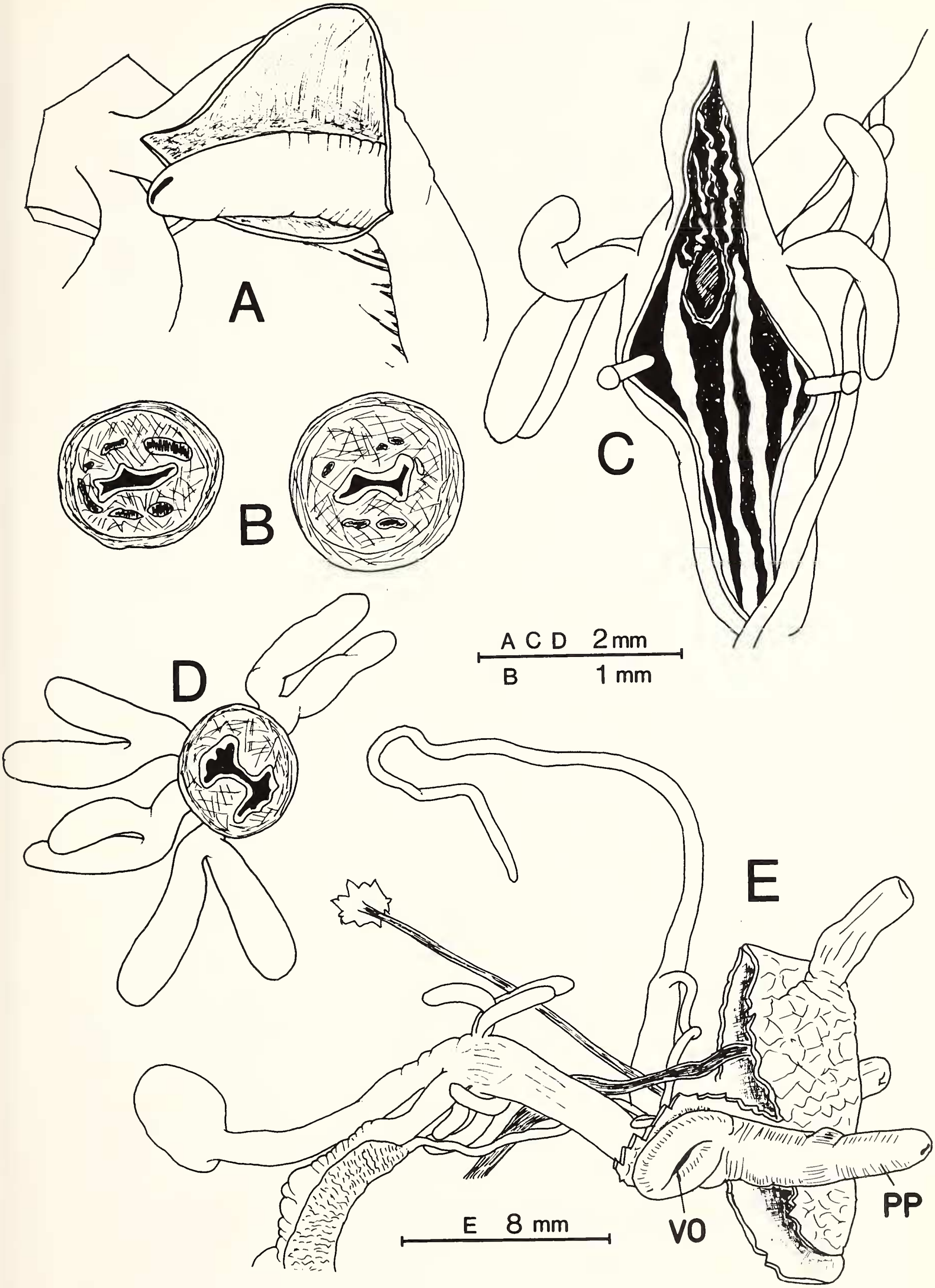

Fig. 15

SMF 69117 labelled as *Monacha (Cyrnotheba) corsica* prevents us from denying the presence of a species of these genera in Corsica.

The fact we failed to find such shells during our studies in Corsica suggests the possibility of an error in the transcription of the collecting site of the Senckenberg material, or substitution of material.

2) *Helix astenia* MABILLE (1880)

This species was described by MABILLE (1880) from an unspecified locality in Corsica, and mentioned by CAZIOT (1902) and HOLYOAK (1983). In the absence of the original material it was necessary to resort to the original description. The «horn-rufescent» colour and obscure subangled last whorl suggest that it may have been a *C. corsica* (SHUTTLEWORTH). However, we should prefer to consult other colleagues before including it in the list of the synonyms of this species.

3) *Helix flava* VILLA, 1836 (non TERVER, 1839).

VILLA (1836) reports this species in Sardinia using a nomen in schedula created by TERVER but not yet published at the time.

Many authors consider *H. flava* TERVER to be a synonym of *Helix lanuginosa* BOISSY (ROSSMÄSSLER, 1839; PFEIFFER, 1848; CLESSIN, 1881; TRYON, 1887). However, *H. flava* TERVER is an Algerian species (from Bougie area), clearly distinct from *G. lanuginosa* (BOISSY) (unpublished personal data). It is not unrealistic to suppose that VILLA was studying one of the two hairy shell species described here as new.

4) *Helix scobinata* (MEGERLE, *ms.*) VILLA 1836.

VILLA (1836) cited *Helix scobinata* MEGERLE among the Sardinian fauna, but this species is completely unknown in current literature and is not listed by PFEIFFER (1848-1877) or in similar catalogues (ALBERS, 1860; KOBELT, 1871; WESTERLUND, 1884-1890, ALZONA, 1971) and therefore probably a *nomen in litteris*. PAULUCCI (1882: 354) thought it referred to a young specimen of her «*Helix corsica*» (not SHUTTLEWORTH, 1843).

5) *Helix telonensis* CAZIOT, 1902 (non MITTRE, 1842) CAZIOT (1902) gave this name to a species present in several localities of northern Corsica. *H. telonensis* MITTRE is usually considered a synonym of *Perforatella glabella* (DRAPARNAUD) (see MOQUIN-TANDON, 1855; CLESSIN, 1881; GERMAIN, 1929, 1930).

HOLYOAK (1983) cited *P. glabella* in Corsica on the basis of the supposed synonymy of the MITTRE and DRAPARNAUD species.

This species may be thus excluded from Corsican fauna. Specimens of this group were completely absent from the material collected by us in Corsica, suggesting once again inappropriate use of a name.

## Species dubiae

1) *Gen. sp.*

It was not possible to identify a number of specimens, some found in old collections simply as shells, others being juvenile specimens with immature genital tract collected by ourselves:

**Corsica:** 1) Desert des Agriates, LANZA leg. 12.4.1977, (1).

**Sardinia:** 1) Capo Caccia, PINTER leg. 5.7.1981, (1); 2) Sardinia, BLAUNER leg., (4). SHUTTLEWORTH (1852) det. *H. corsica*. SHUTTLEWORTH Coll., MNB 710; 3) near Sassari, ADAMI leg., (2) (Pl. 6: Fig. F). ADAMI (1876) and PAULUCCI (1882) det. *H. corsica*. PAULUCCI Coll., MZUF, 4617; 4) near Sassari, Valletta di Logulentu, APPELIUS leg. (3) PAULUCCI (1878) det. *H. lanuginosa*, PAULUCCI (1882) det. *H. corsica*. PAULUCCI Coll., MZUF 4618.

The materials from the Sassari area (Sardinia) and those of BLAUNER, show a clear resemblance to *I. berninii* but their wider umbilicus suggests that they belong to *G. lanuginosa*. The specimen collected in the Desert des Agriates (Corsica) seems closer to *I. berninii* wich is also present in southern Corsica.

## Addendum

While this paper was in press, we have had the opportunity to visit the «Valletta di Logulento» near Sassari. The hairy shelled specimens collected there, perfectly corresponding to those found in the Coll. PAULUCCI (APPELIUS leg., PAULUCCI 1878 det. *H. lanuginosa;* PAULUCCI (1882) det. *H. corsica;* MZUF 4618) revealed to belong to *Ganula lanuginosa* (BOISSY). It seems probable that also the other above listed specimens coming from the Sassari area belong to *G. lanuginosa*.

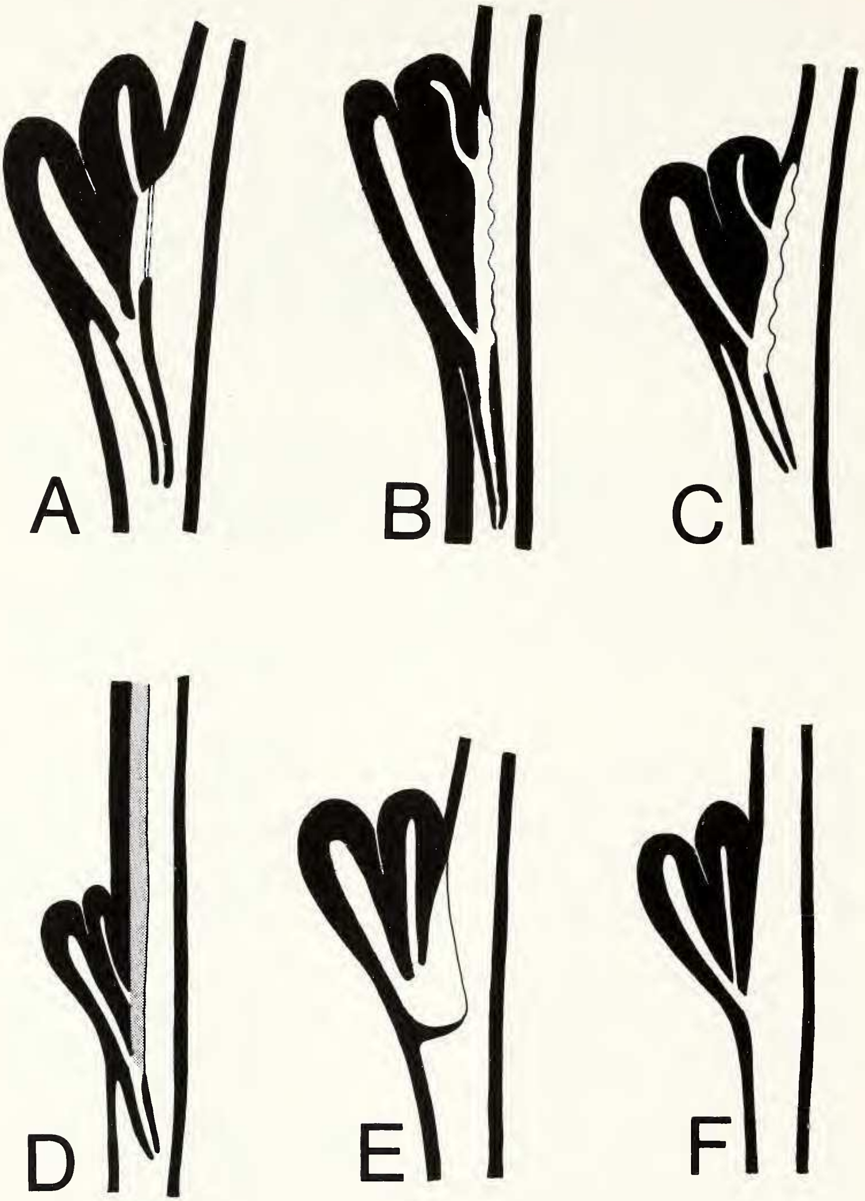

**Fig. 16** - Schematic longitudinal sections of the vagina showing the relationships between the external and internal stylophores and the presence or absence of internal vaginal accessory structures. A: *Hygromia* (s. str.) *cinctella*; B: *Hygromia (Riedelia) limbata*; C: *Zenobiella subrufescens*; D: *Ichnusotricha berninii*; E: *Ganula lanuginosa*; F: *Pyrenaearia carascalensis*. The basal opening of the vaginal cone of *H.* (s. str.) *cinctella* (A) usually appears closed by a strict adhesion of its two lips. A gentle traction is sufficient to open it. In *H. (Riedelia) limbata* (B) and in *Z. subrufescens* (C) the two lips do not adhere and the opening is immediately evident.

## CONCLUSIONS

This analysis would be incomplete if we were not to consider the collocation of the taxa here described in categories of levels higher than genus.

According to a widespread and progressively updated scheme of classification (Zilch, 1960; Forcart, 1965; Solem, 1978; Kerney et. al., 1983, Aparicio, 1986) the European «helicids» may be grouped as follows:

Fam. Sphincterochilidae Zilch, 1960
Fam. Bradybaenidae Pilsbry, 1939
Fam. Elonidae Gittenberger, 1978
Fam. Helicidae Rafinesque, 1815
Subfam. Helicellinae Hesse, 1926
Subfam. Cochlicellinae Schileyko, 1972b
Subfam, Monachinae Zilch, 1960
Subfam. Hygromiinae Tryon, 1866
Subfam. Helicodontinae Hesse, 1907
Subfam. Ariantinae Morch, 1864
Subfam. Helicinae Rafinesque, 1815

The species of Sardinia and Corsica would therefore belong only to the family Helicidae Rafinesque, 1815, partly to the subfamily Monachinae (4) (*Monacha*) and partly to the subfamily Hygromiinae (*Cyrnotheba, Hygromia, Ganula, Ichnusotricha, Nienhuisiella*).

In a long series of papers Schileyko (1970, 1972b, 1972c, 1973, 1978a, 1978b, 1979) showed that the above scheme was inconsistent in places in the light of his new and more accurate interpretation of the anatomical data. An example of this inadequacy is given by Schileyko (1972b) and concerns the subdivision of a group of extremely close genera into two subfamilies, the Helicellinae and the Hygromiinae. The only discriminating character considered was the right ommatophore retractor (r.o. retractor) which is independent of the genitalia in the Helicellinae but passes between penis and vagina in the Hygromiinae (see Germain, 1929, 1930; Hesse, 1931; Pilsbry, 1939). We agree with Schileyko in rejecting such a subdivision and note that in some other Pulmonates the position of the r.o. retractor was not used in such a drastic way for classification purposes. For example in the family Zonitidae, the tribus Zonitini manifests either disposition according to genus (see Riedel, 1980). In the genus *Sphincterochila* the typical subgenus and other subgenera have the r.o. retractor independent of penis and vagina, while in the subgenus *Cariosula* it passes between the two! (see Forcart, 1974) (5). Schileyko finally proposes a new classification scheme in which the whole of the old family Helicidae is divided into a vast series of taxa, both at the family and superfamily levels:

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4) See note 3.

5) According to Schileyko (1972b, 1978b), a r.o. retractor independent of penis and vagina is an advantage for open environment species in that it enables them to copulate while remaining nearly completely within their shells. This opinion is not confirmed by what happens in other species. *Sphincterochila ((s. str.)* and *Sphincterochila (Cariosula)* live in the same habitat as do many genera of Zonitini.

Superfam. Sphincterochiloidea ZILCH, 1960
Fam. Sphincterochilidae ZILCH, 1960
Superfam. Helicodontoidea HESSE, 1907
Fam. Helicodontidae HESSE, 1907
Superfam. Helicoidea RAFINESQUE, 1815
Fam. Helicidae RAFINESQUE, 1815
Fam. Humboldtianidae PILSBRY, 1939
Fam. Helminthoglyptidae PILSBRY, 1939
Fam. Bradybaenidae PILSBRY, 1935
Fam. Corillidae PILSBRY, 1905
Fam. Oreohelicidae PILSBRY, 1939
Fam. Camaenidae PILSBRY, 1895
Fam. Ammonitellidae PILSBRY, 1939
Superfam. Hygromioidea TRYON, 1866
Fam. Hygromiidae TRYON, 1866

He also proposed (SCHILEYKO, 1978a, 1978b) the subdivision of the family Hygromiidae into a long series of subfamilies: Trichiinae ZILCH & JAECKEL, 1962, Hygromiinae TRYON, 1866, Archaicinae SCHILEYKO, 1978b, Euomphaliinae SHILEYKO, 1978b (*nomen novum* pro Monachinae), Paedhoplitinae SCHILEYKO, 1978b, Metafruticicolinae SCHILEYKO, 1972b, Ciliellinae SCHILEYKO, 1972b, Cochlicellinae SCHILEYKO, 1972b, Geomitrinae WENZ, 1923 (6). This new scheme is the result of SCHILEYKO's attempt to create a phylogenetic ordering (1978b: Fig. 33) based on the modifications which the genital apparatus (the only part which seem to have characters appropriate to this end) has undergone. He gives particular consideration to the organs annexed to the vagina (organs of stimulation, stylophores) and to the bursa copulatrix (= gametolytic gland) complex. In this way, the presence of a primitive character, the bursa copulatrix inserted through the diaphragm, characterized Sphincterochiloidea and Helicoidea while a derived (more evolved) character, the bursa copulatrix independent of the diaphragm characterized Hygromioidea and Helicodontoidea. The primitiveness of the organ annexed to the vagina, the organ of stimulation, then distinguishes the Sphincterochiloidea, from the Helicoidea. The latter are considered to derive from an ancestor having four stylophores symmetrically arranged about the vagina, as do the present Humboldtianidae. The dart sacs were then presumably limited down to one (Helicidae, Helminthoglyptidae and Bradybaenidae) or completely disappeared (Camaenidae, Oreohelicidae, Ammonitellidae).

The Helicodontoidea remain a group of unknown affinity, probably distinct from a common Hygromioidea-like ancestor since the Palaeocene (SCHILEYKO *in litt.*).

The Hygromioidea is quite distinct from the Helicoidea which, besides the bursa copulatrix independent of the diaphragm, have realized their own system of vaginally annexed organs, similar but not homologous to that of the primitive Helicoidea.

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6) SCHILEYKO (*in litt.*) has recently changed his mind about the Cochlicellinae and Geomitrinae, which he now considers to be separate families in the Helicoidea (s. lat.). He also considers the Ciliellinae to have uncertain affinities.

They also have realized four stylophores but these are disposed one above the other on only two sides of the vagina.

The primitive complex of stylophores of the Hygromioidea appears to have undergone a slow gradual process of reduction by «oligomerization» as follows (Fig. 17):

1) A: Two pairs of stylophores on opposite sides of the vagina, each pair consisting of a reduced dartless stylophore and a normal stylophore with dart: some Trichiinae.
   B: Only two stylophores, each with dart, disposed on opposite sides of the vagina: some Trichiinae.

2) A: Two stylophores on the same side of the vagina, one reduced and dartless, the other normal and with dart: Archaicinae and some Hygromiinae.
   B: Only one normal stylophore with dart: some Hygromiinae.
   C: Total absence of stylophores: some Hygromiinae.

3) A: Only two stylophores modified into tubular vaginal appendices of variable development, disposed on opposite sides of the vagina: Paedhoplitinae and some Euomphaliinae.
   B: Only one stylophore modified into a tubular vaginal appendix of variable development: some Euomphaliinae.
   C: Total absence of stylophores: some Euomphaliinae.

4) Totale absence of stylophores: Metafruticicolinae.

Other anatomical features (structure of the penial papilla, presence or absence of digitiform glands, shape of the vagina) would allow the resolution of doubtful cases and the collocation in subfamilies of genera in which the absence of stylophores or stylophore-derived structures makes the above scheme inappliable (7).

Taking Shileyko's scheme as valid, the taxa of the Sardo-corsican fauna examined by us all belong to the family Hygromiidae, *Monacha* to the subfamily Euomphaliinae and the others (*Cyrnotheba, Hygromia, Ganula, Ichnusotricha, Nienhuisiella*) to the subfamily Hygromiinae.

The differences between this and the old scheme are apparently minimal. However the superfamily and the family have changed.

Our present knowledge and experience do not permit us to assess the validity of this scheme. Only a researcher like Schileyko, who has personally examined much material of the different groups, could attempt a critical analysis and formulate an alternative. Nevertheless it may be useful to outline some of our queries about Schileyko's scheme.

Firstly, we do not consider that the structure of the genital apparatus alone is of such significance as to justify its use to create taxa of high rank and

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7) The disposition of the r.o. retractor (independent of/or passing between penis and vagina) may be a valid character for discriminating species, or may be used in conjunction with other characters to decide the collocation of a species in this or that genus or subgenus, as in the case of *Spincterochila (Cariosula)*.

form the basis for phylogenetic reconstructions (see SOLEM, 1978). There is no shortage of example in Gastropods of notable structural changes in the reproductive apparatus (see Hydrobiidae: DAVIS et. al. 1976; GIUSTI & BODON, 1983; GIUSTI & PEZZOLI, 1984). These seem to document the ample possibilities of occasional variations and extraordinary convergence phenomena (see the genital tract of *Bythinella, Emmericia* and *Bithynia*). This fact has been used as grounds for objection to SCHILEYKO's proposed classification scheme (PINTER, 1978) and as a reason for adhering to the old scheme (SOLEM, 1978, GITTENBERGER, 1985) but it does not seem to have been taken into account so much in the creation and/or acceptation of other superfamilies and families analogously created solely on the basis of anatomical characters (Bradybaenidae: PILSBRY, 1939; Sphincterochiloidea: FORCART, 1972; Camenacea: SOLEM, 1974, 1978; Elonidae: GITTENBERGER, 1978; etc.).

There seem to be preconceived one-way position or positions which tend to accept high rank splitting only when this causes modest non traumatic opposition to tradition. If we are to reject the scheme proposed by SCHILEYKO, it becomes essential to reconsider all the «helicoid» taxa created to date on the basis of genital tract characters.

Keeping the taxa pertinent to the group of species examined by us, we wish to emphasize that one of the most important factors which led SCHILEYKO do distinguish the Helicoidea from the Hygromioidea was the alleged non homology of their stylophores. This was allegedly demonstrated by the disposition of the stylophores in the Humboldtianidae (from which the Helicidae are supposedly derived) which appears different from that in the Hygromiidae Trichiinae. We think that this opinion warrants careful evaluation.

The clear resemblance in structure of the darts makes it seem unlikely that they appeared by convergence in two different phyletic lines. SCHILEYKO (1978b; *in litt.*) sustains that the Helicoidea and the Hygromioidea are also differentiated by a bursa copulatrix inserted through the diaphragm in the former (primitive character) and free from the diaphragm in the latter (derived character). Even this assumption may be criticized.

In fact in the suborder Helixina SCHILEYKO, 1979, the infraorders Endodontinia SCHILEYKO, 1979 and Zonitinia SCHILEYKO, 1979 considered to be close to the infraorder Helixinia but more primitive (see SCHILEYKO, 1979) have the bursa copulatrix independent of the diaphragm.

It would thus seem that this is the primitive character, not the bursa copulatrix inserted in the diaphragm (8). If we now reject both the theory that the Helicoidea sensu SCHILEYKO (1978a, 1979) (excluding Corillidae, Oreohelicidae, Camaenidae and Ammonitellidae) are more primitive and that the two stylophores arrangements originated independently, the Hygromiidae could

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8) Many species of Camaenidae and Corillidae, families included in the Helicoidea by SCHILEYKO (1978b, 1979) and indicated as having the bursa copulatrix inserted in the diaphragm (see SCHILEYKO, 1978b: Fig. 20) often appear instead to have a bursa with shortened pedunculus and which does not reach the diaphragm (PILSBRY, 1939; SOLEM, 1984). The value of this character should therefore be reconsidered. It is important to remember that the above mentioned families are of uncertain position and that SOLEM (1978) considers Camaenidae, Oreohelicidae and Ammonitellidae as belonging to a separate superfamily «Camaenacea» and the Corillidae to the superfamily «Polygiracea».
SCHILEYKO (*in litt.*) has recently changed his mind about the Corillidae suggesting that they are separate from the Helicoidea.

be considered a primitive offshot of the tree from which the Humboldtianidae, Helicidae, Helminthoglyptidae, Bradybaenidae and probably also the Sphincterochilidae originated. As a result all the groups of species collected by SCHILEYKO in the Helicoidea (with the exclusion of Camaenidae, Oreohelicidae, Ammonitellidae and Corillidae), the Hygromioidea and the Sphincterochiloidea (9) could be included in a single superfamily. In this case it only remains to specify that the «stimulating apparatus» of *Sphincterochila* is nothing more than the ancestral organ from which stylophores originated or even (why not?) than a reduced and modified stylophore, similar to that of the Helminthoglyptidae and Bradybaenidae.

The result is a single superfamily, Helicoidea, corresponding entirely to the «Helicacea» sensu SOLEM (1978).

Other objections could be raised to the subdivision of the family with which we have been most concerned, namely the Hygromiidae. The scheme of division into subfamilies proposed by SCHILEYKO on the basis of supposed evolutionary trends in the modification of the stylophores (Fig. 17) is certainly logical. However the relationships that SCHILEYKO supposes to exist between one subfamily and another are not the only one possible. If the Trichinae 2 + 2 stylophores are really the most primitive group, according to SCHILEYKO the group of Trichinae with 1 + 1 stylophores (*Helicella*), the Archaicinae, the primitive Hygromiinae with 2 stylophores (*Hygromia* etc.) and the primitive Euomphaliinae with 1 + 1 vaginal appendices (= modified stylophores) (*Euomphalia* etc.) are all derived therefrom. From the primitive Hygromiinae, other Hygromiinae with only one stylophore (*Perforatella, Monachoides*, etc.) or without stylophores (*Circassina* sensu SCHILEYKO, partim!) then appeared. From the primitive Euomphaliinae appeared forms with only one vaginal appendix (*Monacha* s. str.). From the latter, other Euomphaliinae with no residues of stylophores arose: *Monacha (Metatheba), Monacha (Szentgalia)* and the Metafruticicolinae.

Sometimes the possibility of a gradual passage from one group to another seems to be confirmed by SCHILEYKO (1978).

For example, we may suppose that the Hygromiinae with only one stylophore (*Perforatella, Monachoides*, etc.) were reached by a gradual reduction of the inner stylophore, by a series similar to the present day *Hygromia - Lozekia - Chilanodon - Lindholmomneme* which are all mesophyl genera in which the r.o. retractor passes between penis and vagina. The situation is different in the case of another Hygromiinae, *Candidula*, a xerophilous genus with only one stylophore and r.o. retractor independent of penis and vagina. Here there are no progressive series to document a possible evolutionary line. *Candidula* could equally be derived from a xerophilous Hygromiinae (*Cernuella*) with r.o. retractor independent of penis and vagina by disappearance of the internal stylophore or from a xerophilous Trichiinae (*Helicella*) with 1 + 1 stylophores and r.o. retractor independent of penis and vagina, by disappearance of one of the two opposite stylophores.

The case of genus *Monacha* is emblematic. As described in the discussion of the species, the small sac-like structure located near the base of the appen-

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9) The presence of a smooth jaw in the Sphincterochilidae seems to differentiate them from the «Helicoidea». Nevertheless the value of this character is still uncertain. There are families in which species with ribbed or smooth jaws coexist (see Camaenidae: SOLEM, 1984).

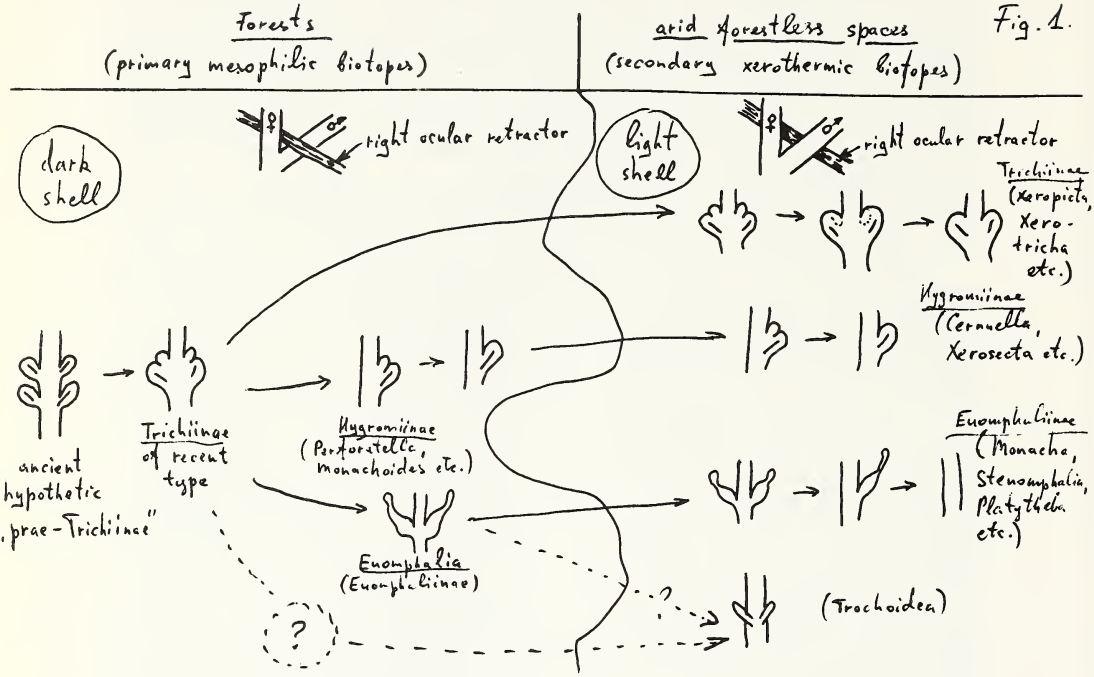

**Fig. 17** - Scheme of the supposed evolutionary trends in the modification of the stylophore according to Schileyko (from Schileyko's original drawing *in litt.*).

dicula vaginalis may be interpreted as vestiges of a second stylophore, sometimes the inner (*M. cartusiana*) and sometimes the outer one (*M. cantiana*).

So instead of deriving from the Euomphaliinae (by disappearance of one of the two opposite vaginal appendices), we can consider *Monacha* to be derived from a Hygromiinae by reduction of one stylophore and transformation of the other into appendicula vaginalis.

The same penial papilla structure in both *Monacha* and *Euomphalia* is not proof of a direct relationship of descendance between the two. Similar penial papillae are also found in other groups of terrestrial Pulmonates and evidently occur by convergence (10). The same applies whether the two saclike structures at the base of the appendicula vaginalis in the two *Monacha*

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10) Besides, according to Schileyko's (1798b) drawings, not all the Euomphaliinae have a penial papilla similar to that of *Euomphalia* and *Monacha* (s. str.). We can cite *Karabaghia bituberosa, Stenomphalia (Diplobursa) psiiformis, Stenomphalia (Harmozica) ravergieri, Monacha (Paratheba) fruticola, Monacha (Paratheba) talyschana* and *Monacha (Boemia) subcartusiana.*

studied be newly acquired structures not derived from regressed stylophores or simply part of the base of the single appendicula vaginalis. *Monacha* may thus have originated from a Hygromiinae with two stylophores by reduction of one and transformation of the other, or from a Hygromiinae with one stylophore transformed into appendicula vaginalis. Analogous alternative hypotheses are possible for the taxa without stylophores or stylophore derivates. All these taxa could therefore theoretically be derived directly from any taxon having stylophores without gradually changes implying the progressive reduction of the first four stylophores to two and then to one (see the uncertain affinity which according to SCHILEYKO is shown by the Ciliellinae). From this brief analysis the limitations of high rank classification based only on genital apparatus characters becomes apparent. As we have seen, however, the only known characters upon which a classification scheme could be based, are those of the genital apparatus. These characters have therefore been widely used, not only by SCHILEYKO.

Nevertheless the classification schemes so based are subjective, varying from one author to another with the creation of taxa of different rank, sometimes raised from subfamily to family (or superfamily) or demoted from family to subfamily.

As it is obviously impossible for us to prepare a new scheme or to continue to utilize the old one, there are only two possibilities:

1) reject all forms of classification until more detailed studies have been performed;
2) accept SCHILEYKO's classification provisionally as a guideline.

Despite the problems which we have raised, the general form of SCHILEYKO's classification seems to us to be the most logical and detailed ever proposed. We therefore feel obliged to conform to it, subject to following modifications.

In the unique superfamily Helicoidea (which thus comprises the Sphincterochiloidea, Hygromioidea and may be the Helicodontoidea), all the families listed by SCHILEYKO (1978b, 1979), with the exception of Corillidae, Camaenidae, Oreohelicidae and Ammonitellidae (8), should be included. The Hygromiidae are accepted as having a status independent of the Helicidae. The subfamilies of the Hygromiidae described by SCHILEYKO (Trichiinae, Hygromiinae, Archaicinae, Paedhoplitinae, Euomphalinae Metafruticolinae) are accepted even if their reciprocal relationships have to be better understood (see note 6).

Though without stylophores, *Cyrnotheba* may be grouped with the Hygromiinae (sensu SCHILEYKO). A similar conclusion applies to *Nienhuisiella* and *Ichnusotricha*. It is well to remember here that *Nienhuisiella* may be considered to be derived from either a Hygromiinae with two stylophores (the very genus *Ichnusotricha* or a form similar to *Hygromia*) or a Hygromiinae with only one stylophore (such as *Perforatella* or *Monachoides*).

There are still many problems for *Monacha*. In our opinion, this genus could be removed from the Euomphaliinae and either placed among the «incertae sedis», or, doubtfully, placed in a separate subfamily.

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## Summary

The authors have studied a group of small helicoids living in the islands of Sardinia and Corsica. Shell structure and anatomy of each species were investigated with the aim of revising taxonomical status and elucidating affinities. Some of the species are described as new and as belonging to new genera. The data collected also enables a new interpretation of the genera *Monacha, Cyrnotheba* and *Hygromia.* A critical analysis of supra-generic systematics of the entire group concludes the paper.

## Riassunto

Gli autori hanno effettuato la revisione di un gruppo di piccoli elicoidi viventi in Sardegna e in Corsica.

L'esame anatomico effettuato su tutte le specie ha consentito di meglio definirne le caratteristiche più significative e di metterne in luce i rapporti. Sono stati risolti, in particolare, i problemi riguardanti due classiche specie della Corsica descritte da Shuttleworth (1843, 1852): *Helix corsica* e *Helix perlevis.* Mentre il primo taxon è rappresentato da una buona specie che deve essere ascritta al genere *Cyrnotheba*, il secondo costituisce un più giovane sinonimo di *Monacha cantiana.* Si è potuto dimostrare, inoltre, come la gran parte dei numerosi materiali della Sardegna citati da vari autori con i due nomi sopra ricordati appartenessero, in realtà, a due nuove specie. Le particolarità anatomiche di queste ultime si sono rivelate tanto marcate da consentire la creazione di due distinti nuovi generi. Viene, inoltre, fornita la ridescrizione sintetica dei generi *Hygromia, Zenobiella, Pyrenaearia, Lozekia* e *Ganula.* Una analisi critica delle più recenti proposte riguardanti la sistematica sopragenerica degli Helicoidea e, in particolare, quella della famiglia Hygromiidae, conclude il lavoro.

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# EXPLANATIONS OF THE PLATES

**Plate 1** - Figs. A-D: *Monacha* (s. str.) *cartusiana* MÜLLER), specimens collected respectively near: Monte delle Case near Cantoniera Rosario (SS, Sardinia; GANDIN leg.) (A); Aleria (Corsica) (B); Arbatax (Sardinia, NIENHUIS leg.) (C); Francardo (Corsica) (D).
Figs. E-G: *Monacha* (s. str.) *cantiana* (MONTAGU): lectotypus (E), one of the paralectotypi (F) and original label of *Helix perlevis* SHUTTLEWORTH (SHUTTLEWORTH Coll., NMB 715) from Aleria (Corsica).

**Plate 2** - *Monacha* (s. str.) *cantiana* (MONTAGU) from different Corsican localities: Bastia (Ex CAZIOT Coll., SMF 69130) (A); Bastia (B-C, E); Bonifacio (D); Foce di Lera near Bonifacio (PINTER leg.) (F); Etang de Biguglia (HOLYOAK leg.) (G).
Fig. H: an enlarged portion of the shell of G to show the hairs which originate in the periostracal layer.

**Plate 3** - *Cyrnotheba corsica* (SHUTTLEWORTH) from historical collections.
Figs. A-C: lectotypus (A), paralectotypus (B) and original label (C) of *Helix corsica* SHUTTLEWORTH (SHUTTLEWORTH Coll., NMB 709) from Aleria (Corsica).
Fig. D-E: lectotypus (D) and its original label (E) of *Helix (Theba) bastitensis* CAZIOT (Ex CAZIOT Coll., NMW 48470) from Bastia (Corsica).

**Plate 4** - Figs. A-F: *Cyrnotheba corsica* (SHUTTLEWORTH) from different Corsican localities: near Olmeto (A, F); Forêt de u Coscione (B); Forêt de Marmano (C, E); near Ucciani (HOLYOAK leg.) (D).
Fig. G: *Ganula lanuginosa* (BOISSY) from Palma de Mallorca (Balearic Islands, ALZONA leg.).

**Plate 5** - *Ichnusotricha berninii* n. sp..
Fig. A: Holotypus, collected in the Park of the Marquis of Laconi (Sardinia).
Fig. B: one of the paratypi chosen from the shells of the PAULUCCI Coll. (MZUF), collected near Laconi (CAROTI leg.) and published by PAULUCCI (1882, Pl. 3: Figs. 4-4a-4b) as *H. perlevis*.
Figs. C-D: Sardinia (BLAUNER leg.), SHUTTLEWORTH (1852) det. as. *H. perlevis*.
Figs. E, H: two shells from Monte Settefratelli (Sarrabus, Sardinia).
Figs. F-G: two shells from Monte Scopeto near Bonifacio (Corsica).

**Plate 6** - Figs. A-E: *Nienhuisiella antonellae* n. sp. from different Sardinian localities. Holotypus (A) and one of the paratypi (D), collected near San Giovanni's Cave (Domusnovas).
Other specimens: Prauni Strinctu near Siddi (PUDDU leg.) (B); near Fluminimaggiore (C,E).
Fig. F: *Gen. sp. indet.* Specimen from PAULUCCI Coll. (MZUF) collected near Sassari and published by ADAMI (1876) and PAULUCCI (1882, Pl. 3: Figs. 5-5a-5b) as *H. corsica (see Addendum)*.

**Plate 7** - The external shell surface of a specimen of *Monacha* (s. str.) *cantiana* (MONTAGU) from Bonifacio (Corsica).
Fig. A: a detail of the protoconch. Note the minute spiral striae (180X).
Fig. B: detail of the teleoconch whorls. Note the many scars corresponding to the bases of the hairs (55X).
Fig. C: detail of the periostracal spiral crests covering wide portions of the teleoconch surface (900X).
Figs. D-E: two hairs (D: 230X, E: 460X).

**Plate 8** - Figs. A-B: external shell surface in a specimen of *Monacha* (s. str.) *cartusiana* (MÜLLER) from St. Florent (Corsica). A: detail of the protoconch showing the minute spiral striae (130X); B: detail of the teleoconch showing the periostracal spiral crests, irregularly spaced and branched (1000X).
Figs. C-D: external shell surface of the teleoconch in a specimen of *Hygromia (Riedelia) limbata* (DRAPARNAUD) from Lourdes (France). C: between two growth lines the periostracal layer shows some nail-like scales (400X); D: detail of a group of nail-like scales (850X).
Figs. E-F: external shell surface of the teleoconch in a specimen of *Hygromia* (s. str.) *cinctella* (DRAPARNAUD) collected at Ghisonaccia (Corsica). E: large portions of the shell surface show nail-like scales (45X); F: a detail of the nail-like scales (700X).

**Plate 9** - The external shell surface in a specimen of *Cyrnotheba corsica* (Shuttleworth) collected near Olmeto (Corsica).
Figs. A-B: details of the prococonch surface showing many rows of tubercles (A: 90X, B: 270X).
Fig. C: detail of the passage zone between the protoconch and the teleoconch. The tubercles are gradually substituted by nail-like scales (135X).
Figs. D-E: detail of the external surface of the teleoconch.
The periostracal layer gives rise to transversal rows of nail-like scales and to minute longitudinal crests (D: 270X, E: 900X).

**Plate 10** - Figs. A-C: the external shell surface in a specimen of *Ichnusotricha berninii* n. sp. collected on Monte Pilai near Bonorva (Sardinia). A: detail of the protoconch: note the minute spiral striae (90X); B: detail of the periostracal layer of the teleoconch showing some hairs and the minute longitudinal crests commonly fragmented into rows of drop-like structures (90X); C: a hair (270X).
Figs. D-F: the external shell surface in a specimen of *Ganula lanuginosa* (Boissy) collected at Porto Cristo (Mallorca, Balearic Islands, Gasull leg.) D: the protoconch and first whorls. The hairs are present from the very beginning of the teleoconch (90X); E: detail of the periostracal layer of the teleoconch showing a hair and a series of minute longitudinal crests partially fragmented into rows of drop-like structures (230X); F: the periostracal crests are often interrupted or are missing for variable portions of the shell surface (90X).

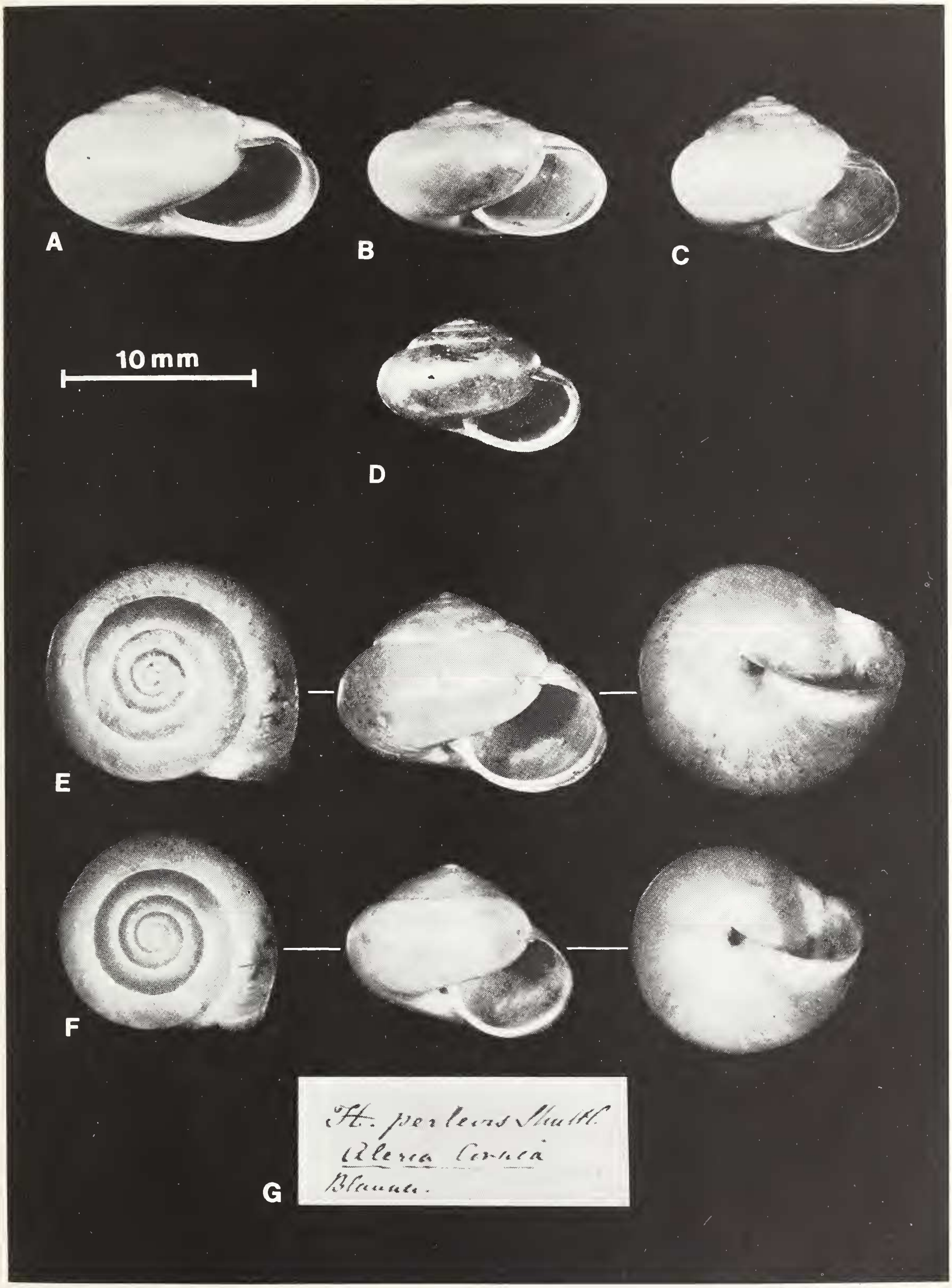
**Plate 11** - The external shell surface in a specimen of *Nienhuisiella antonellae* n. sp. collected near San Giovanni's Cave (Domusnovas, Sardinia).
Fig. A: a detail of the protoconch (80X).
Fig. B: a detail of the teleoconch. Note the very long hairs and the minute longitudinal periostracal crests (90X).
Fig. C: a hair and the crests fragmented into rows of small drop-like structures (270X).
Fig. D: a detail of the periostracal crests (900X).

**Plate 12** - Figs. A-D: the radula of a specimen of *Monacha* (s. str.) *cartusiana* (Müller) from St. Florent (Corsica) (900X). A: central tooth and first lateral teeth; B: 7th-10th lateral teeth; C: 18th-25th latero-marginal teeth; D: extreme marginal teeth.
Fig. E: the jaw of a specimen of *Cyrnotheba corsica* (Shuttleworth) from the Forêt de Restonica (Corsica) (56X).
Fig. F: the jaw of a specimen of *Hygromia* (s. str.) *cinctella* (Draparnaud) from Ghisonaccia (Corsica) (70X).
Fig. G: the jaw of a specimen of *Monacha* (s. str.) *cartusiana* (Müller) from St Florent (Corsica) (60X).
Fig. H: the jaw of a specimen of *Ichnusotricha berninii* n. sp. from Laconi (Sardinia) 50X).

**Plate 13** - The radula of a specimen of *Monacha* (s. str.) *cantiana* (Montagu) (Figs. A-C) from Bonifacio (Corsica) and of *Hygromia* (s. str.) *cinctella* (Draparnaud) (Figs. D-F) from Ghisonaccia (Corsica) (900X). A, D: central tooth; B: 17th-19th latero-marginal teeth; E: 10th-12th latero-marginal teeth; C, F: extreme marginal teeth.

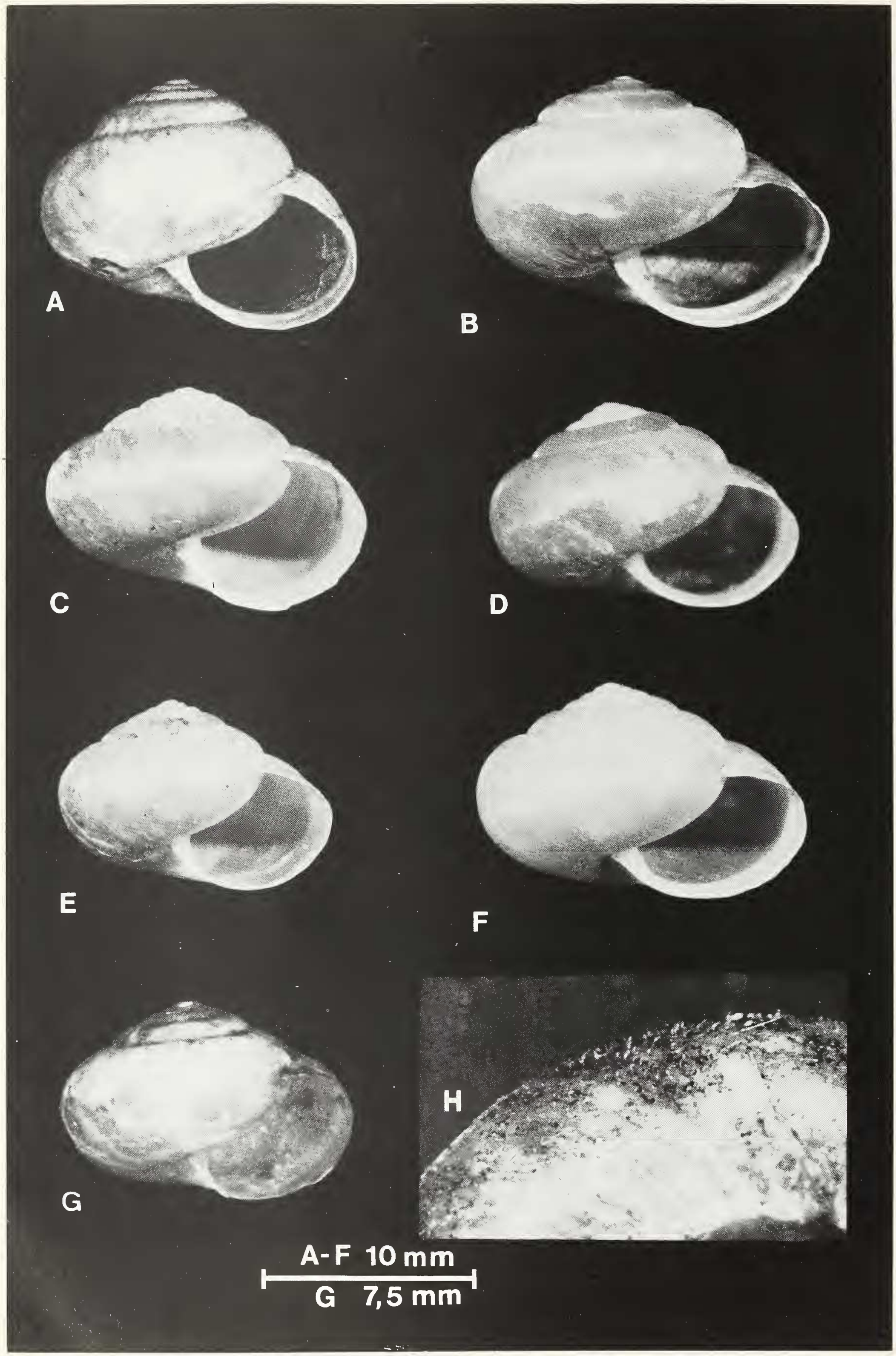
**Plate 14** - The radula of a specimen of *Cyrnotheba corsica* (Shuttleworth) (Figs. A-D) from Forêt de Valdoniello (Corsica) and of *Ganula lanuginosa* (Boissy) (Figs. E-H) from Porto Cristo (Mallorca, Balearic Islands, Gasull leg.) (900X). A, E: central tooth and first lateral teeth; B: 10th-12th lateral teeth; F: 8th-10th lateral teeth; C: 17th-21th latero-marginal teeth; G: 24th-27th latero-marginal teeth; D, H: extreme marginal teeth.

**Plate 15** - The radula of a specimen of *Nienhuisiella antonellae* n. sp. (Figs. A-C) from outside of San Giovanni Cave near Domusnovas (Sardinia) and of *Ichnusotricha berninii* n. sp. (Figs. D-F) from Laconi (Sardinia) (900X). A-D: central tooth and first lateral teeth; B: 9th-12th lateral teeth; E: 10th-12th lateral teeth; C-F: extreme marginal teeth.



H. perlevis Shuttl.
Aleria Corsica
Blauner.

Tav. 1



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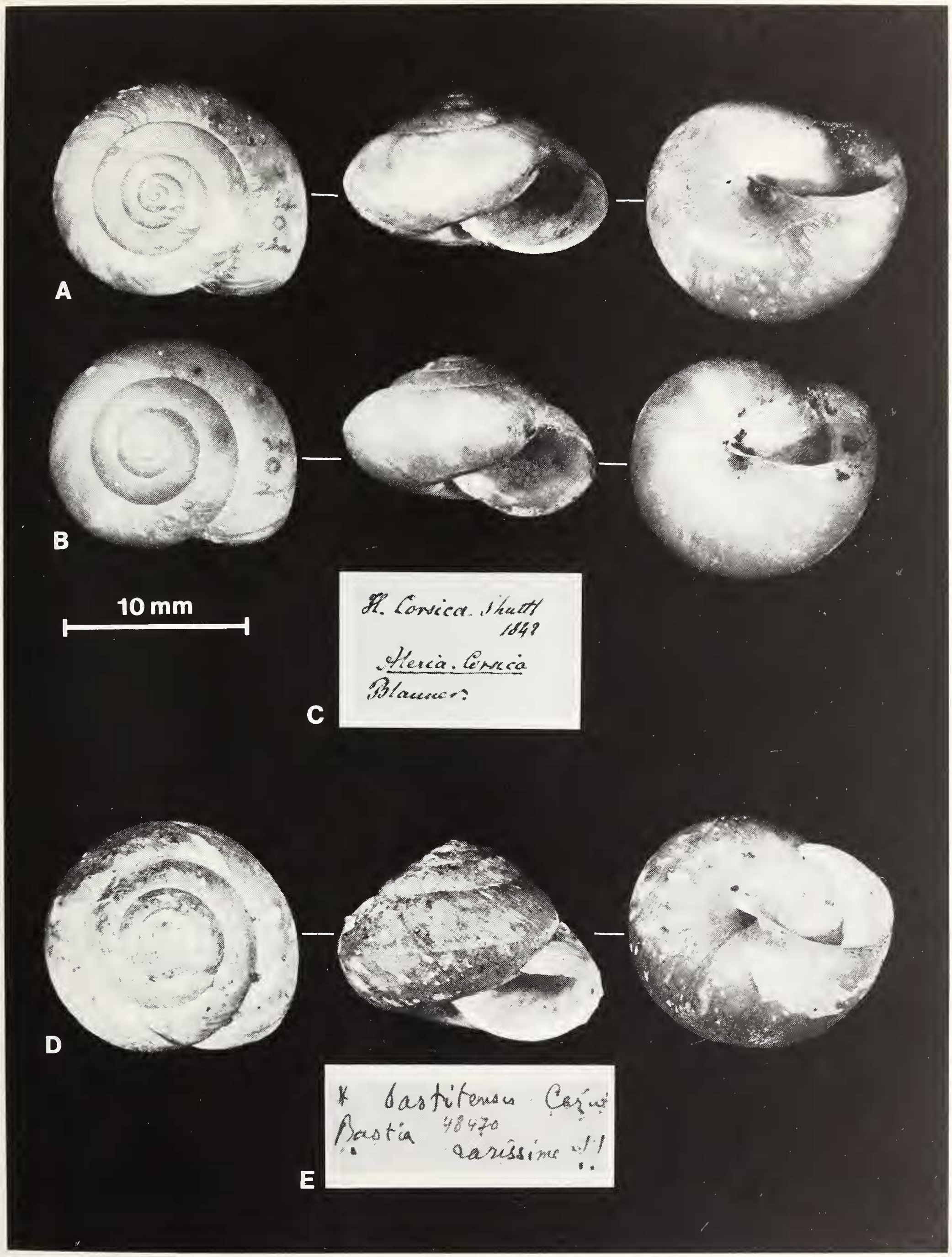
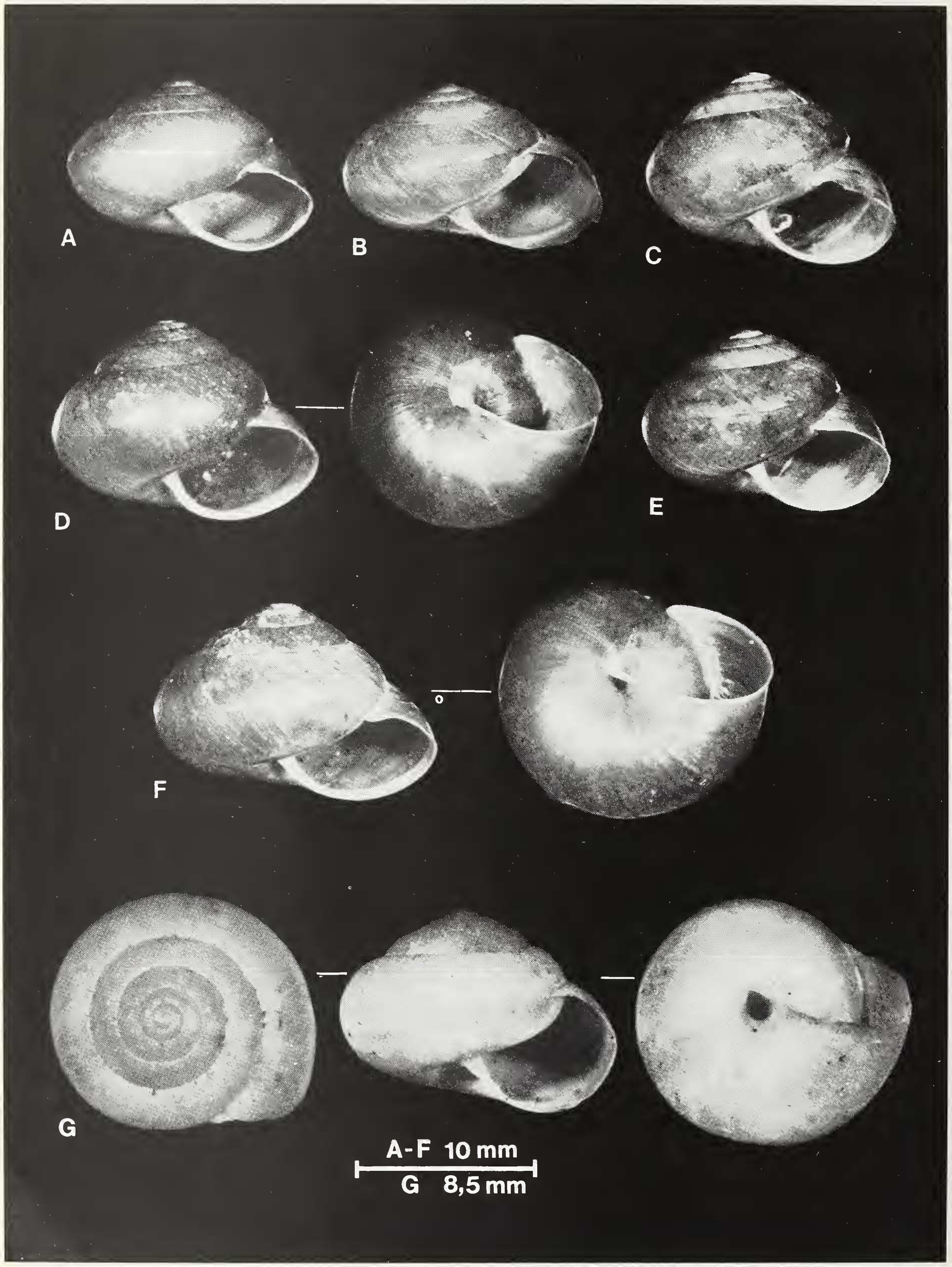


H. Corsica Shutt
1849
Aleria. Corsica
Blauner

✱ bastitensis Caziot
Bastia 48470
rarissime !!

Tav. 3



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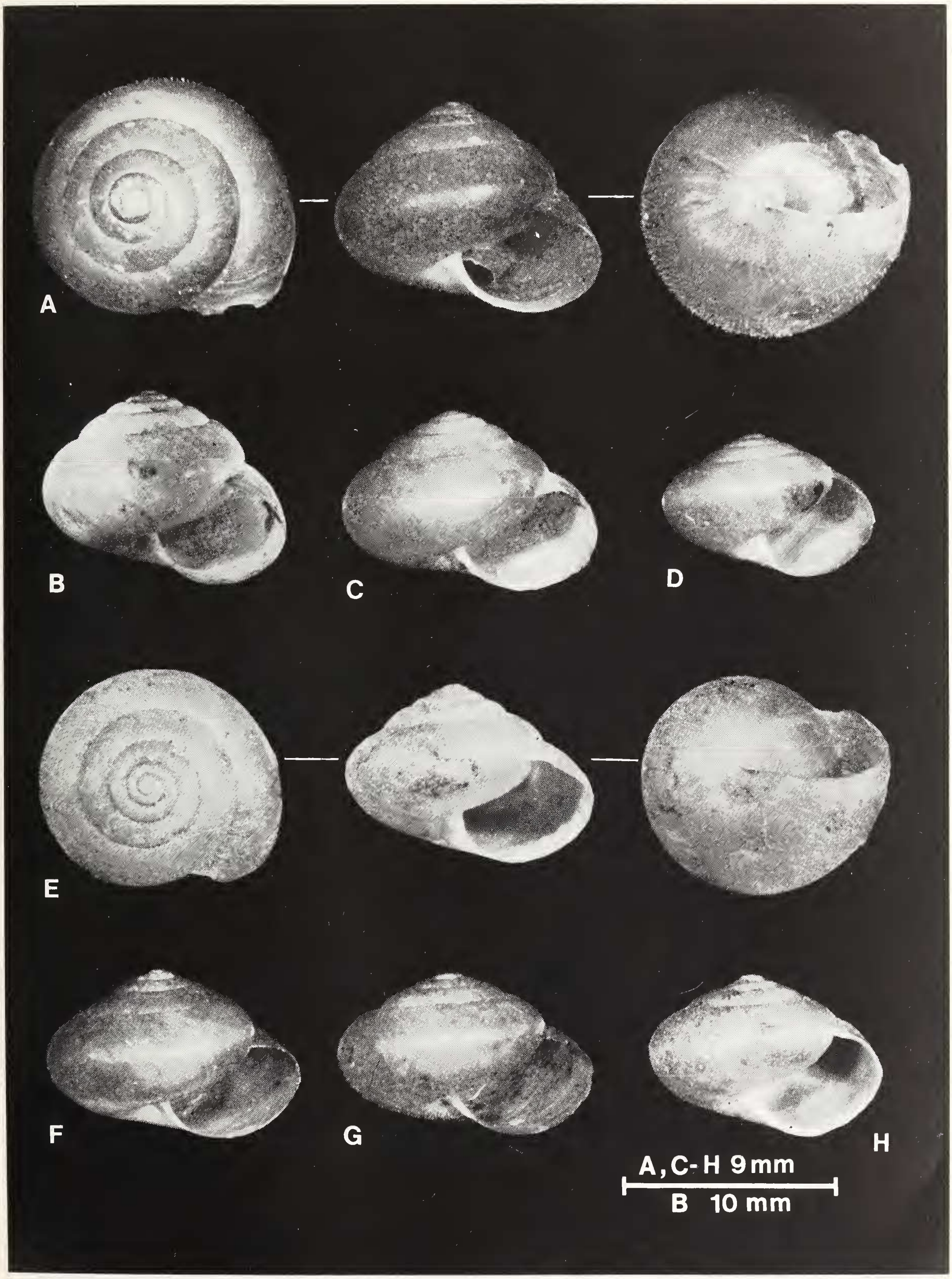

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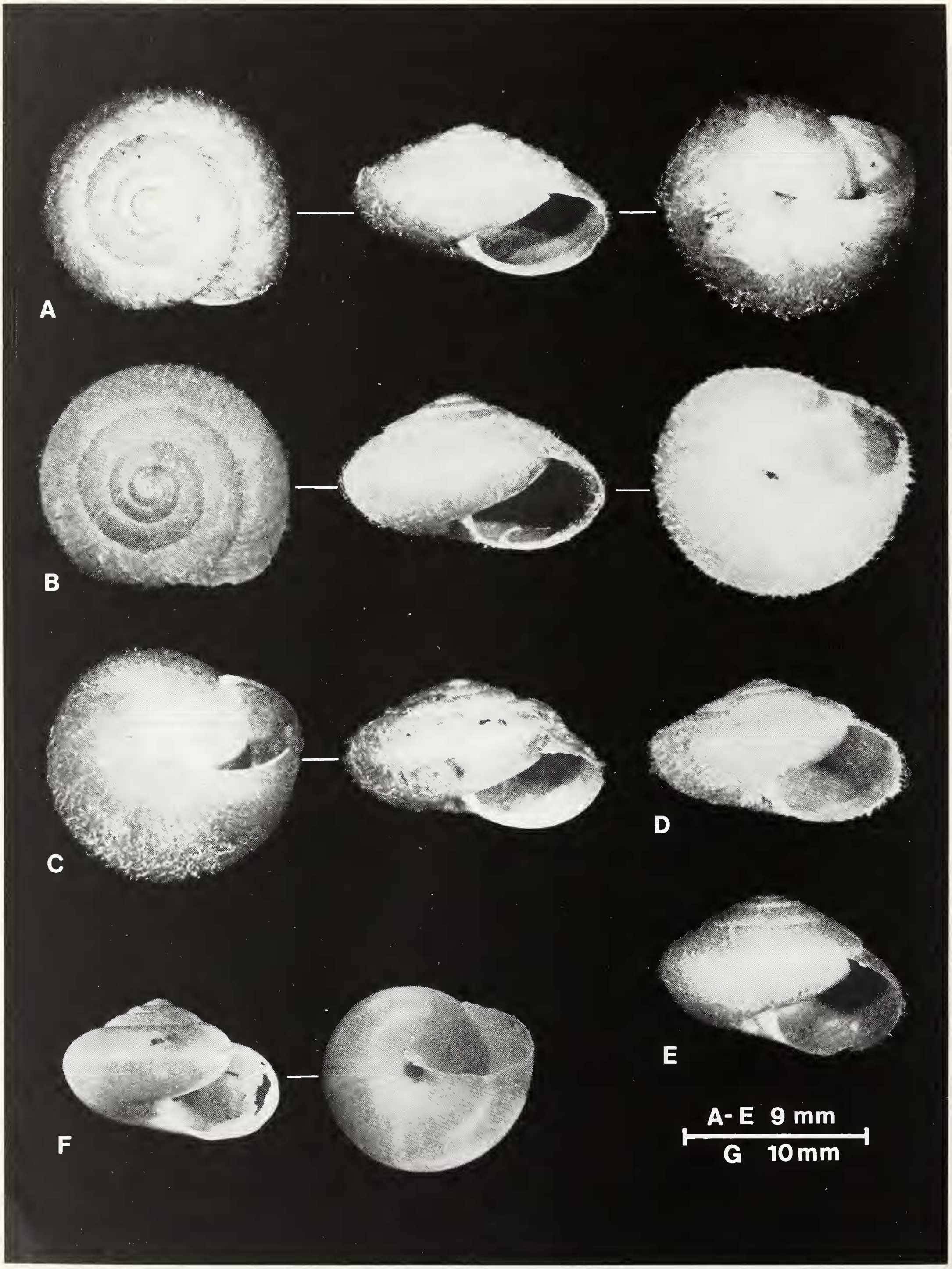

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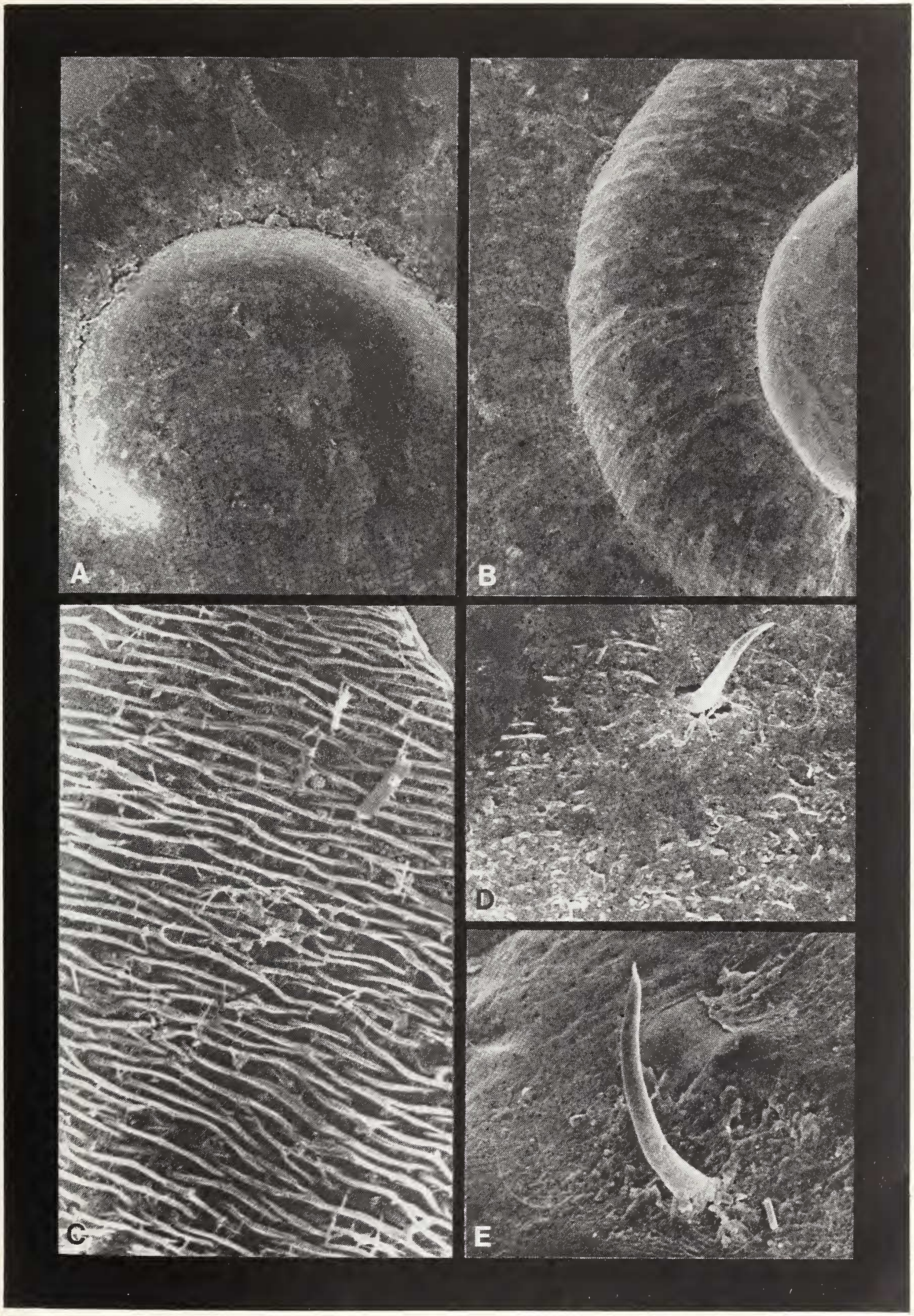

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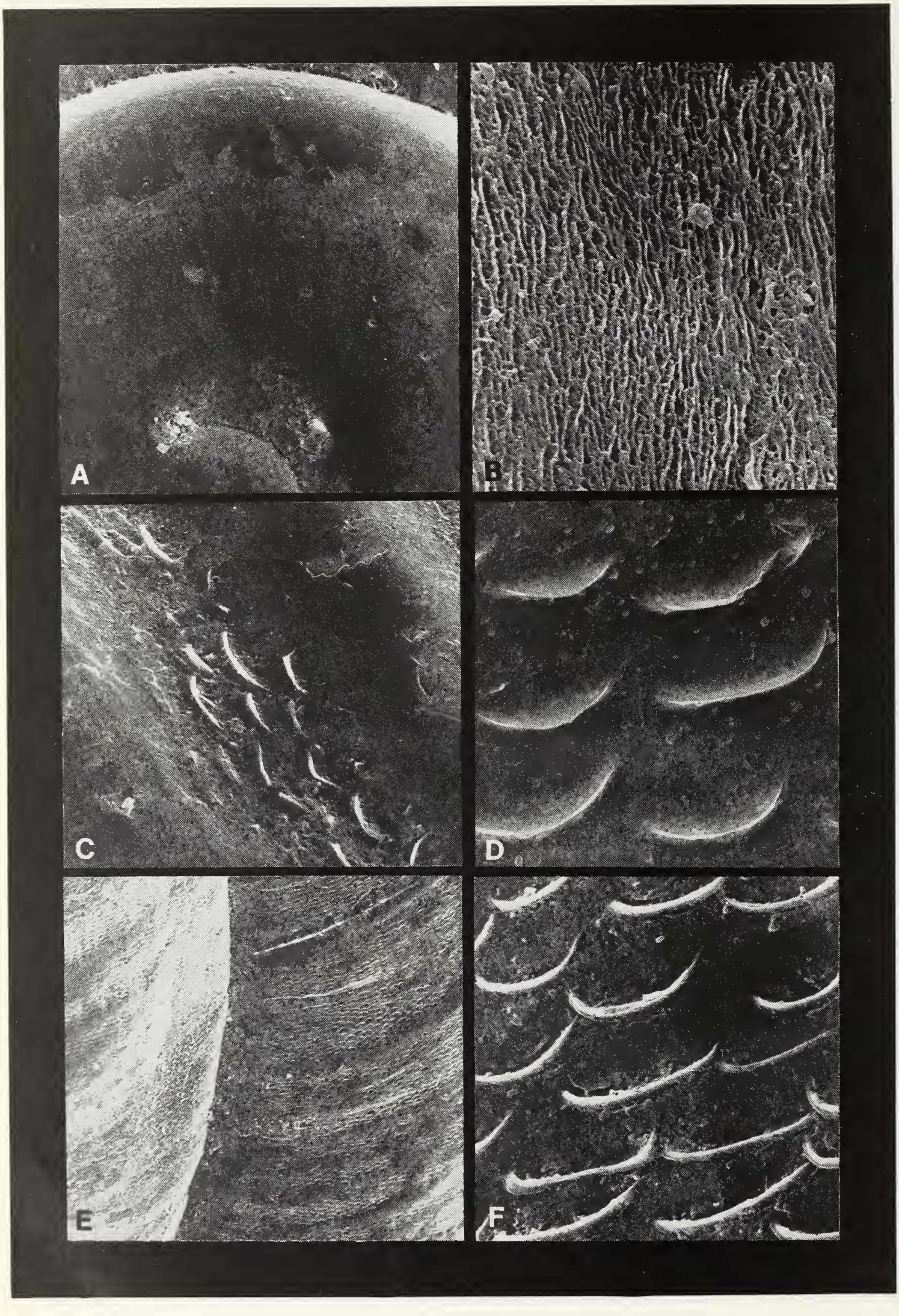

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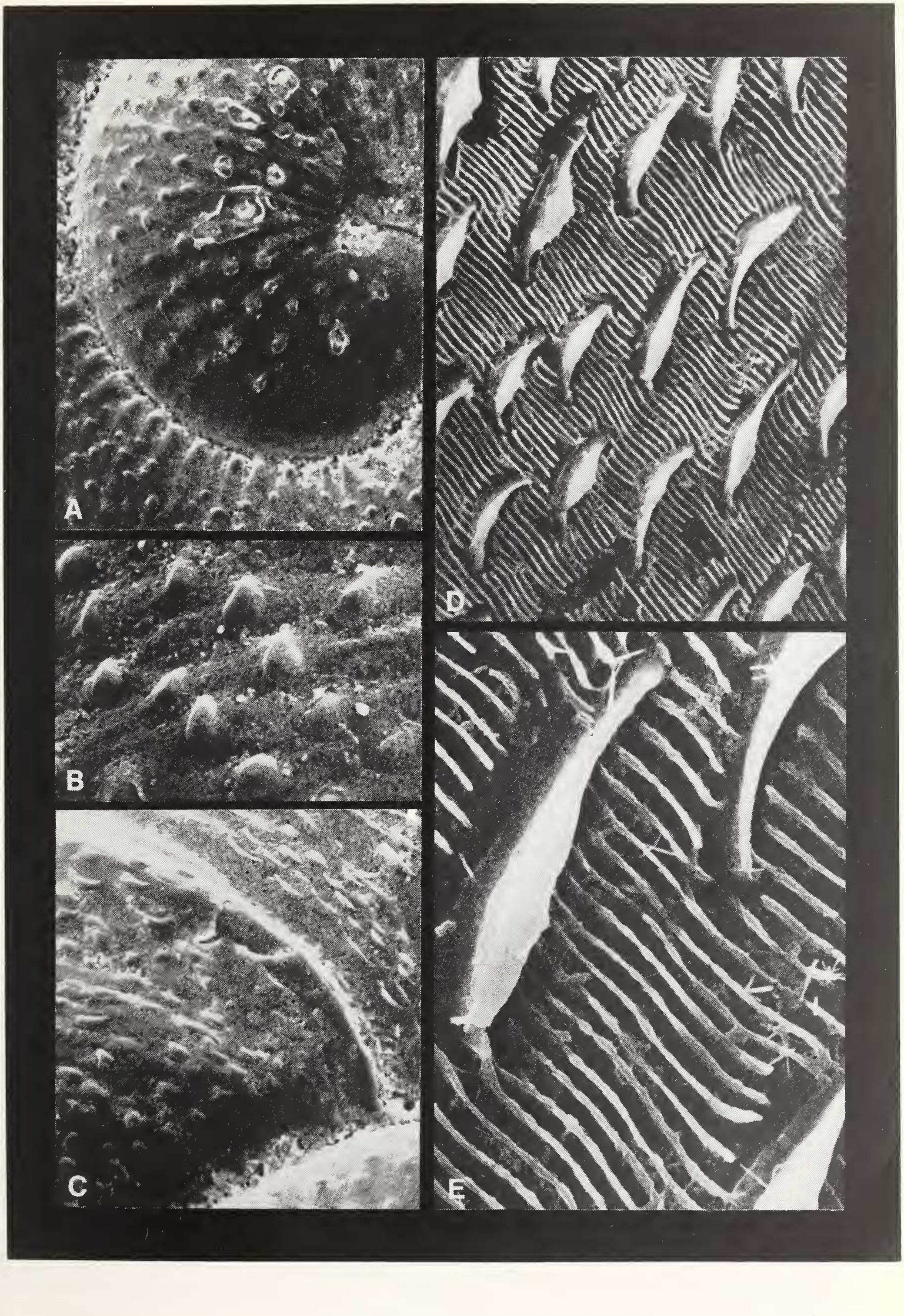

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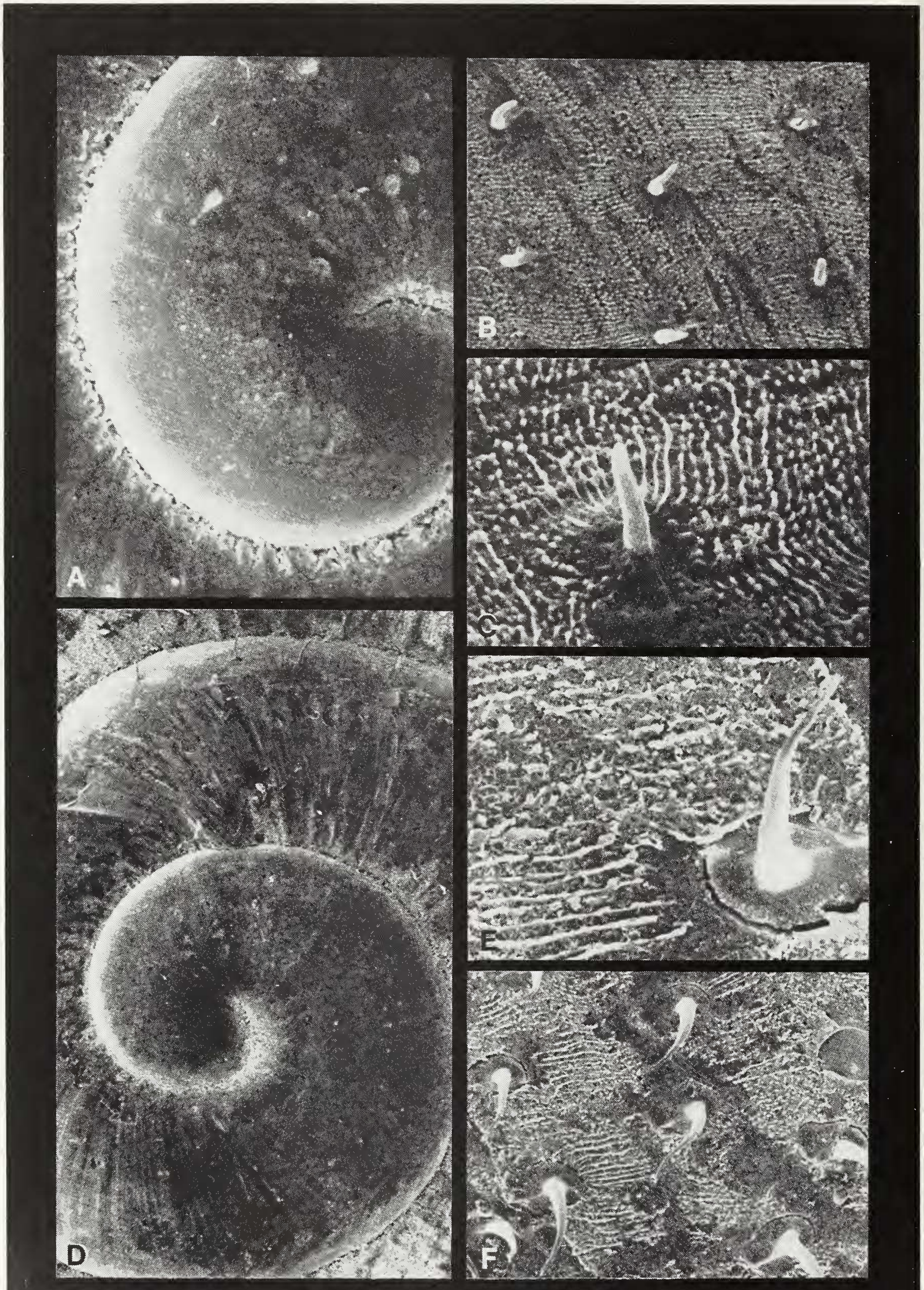

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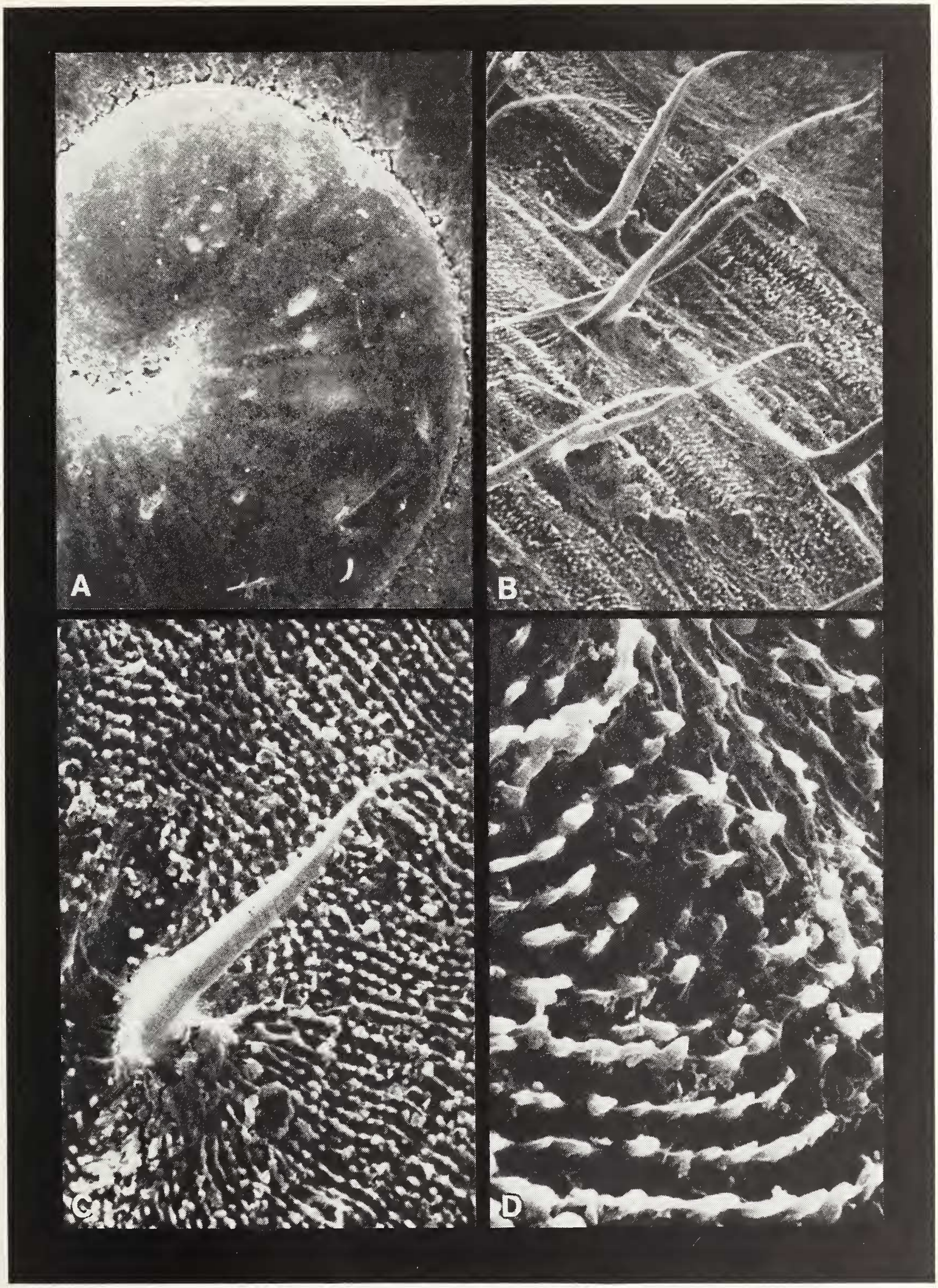

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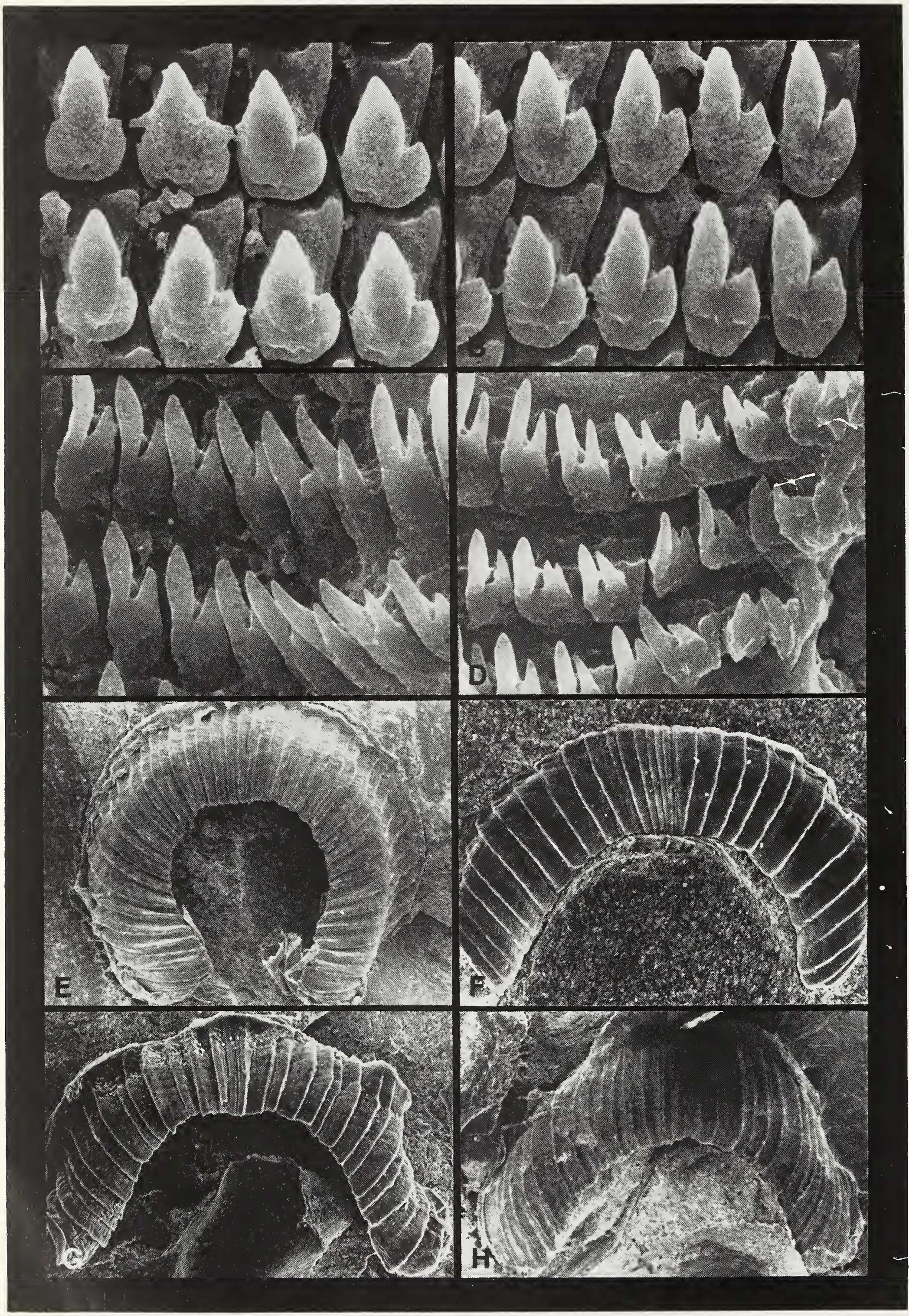

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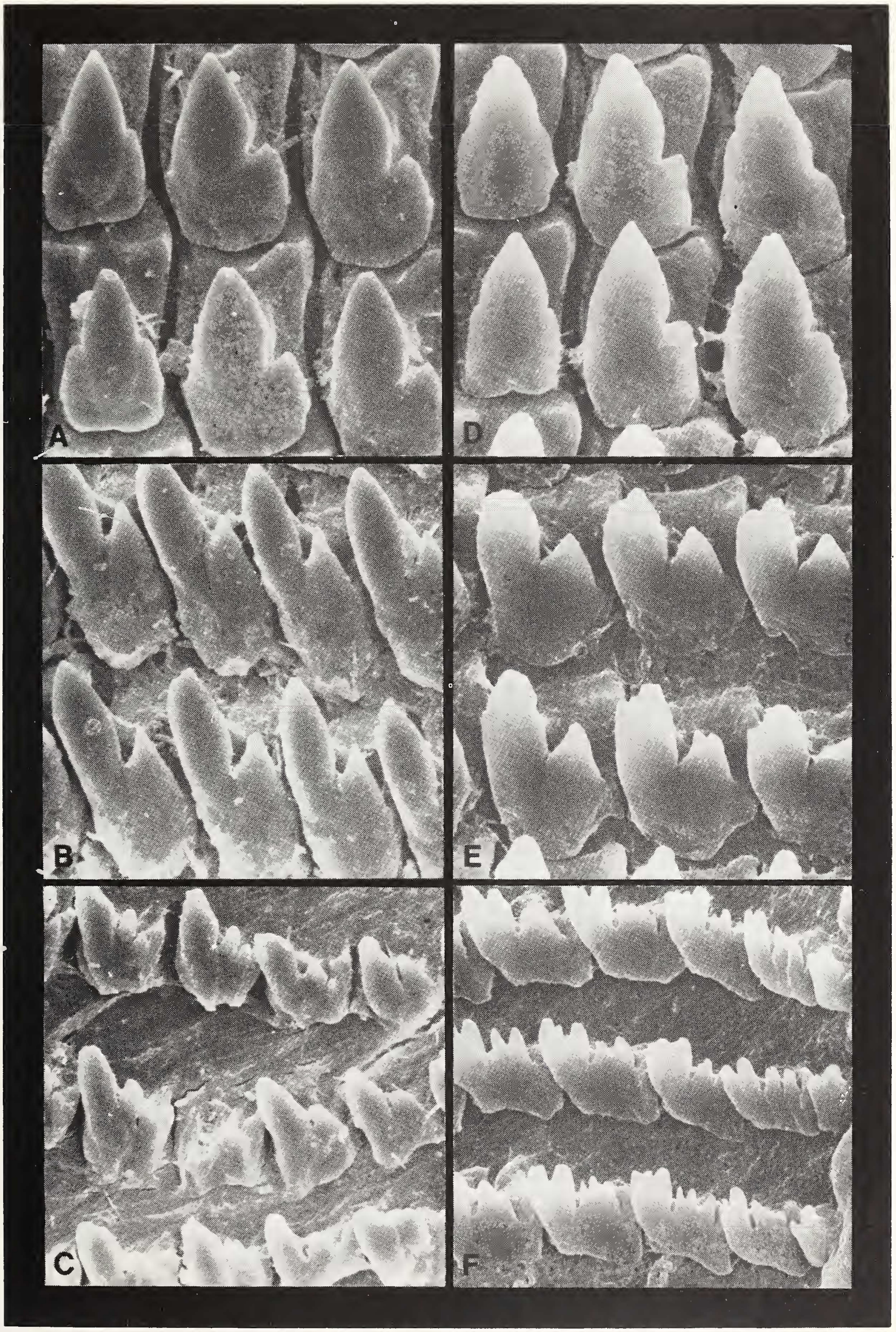

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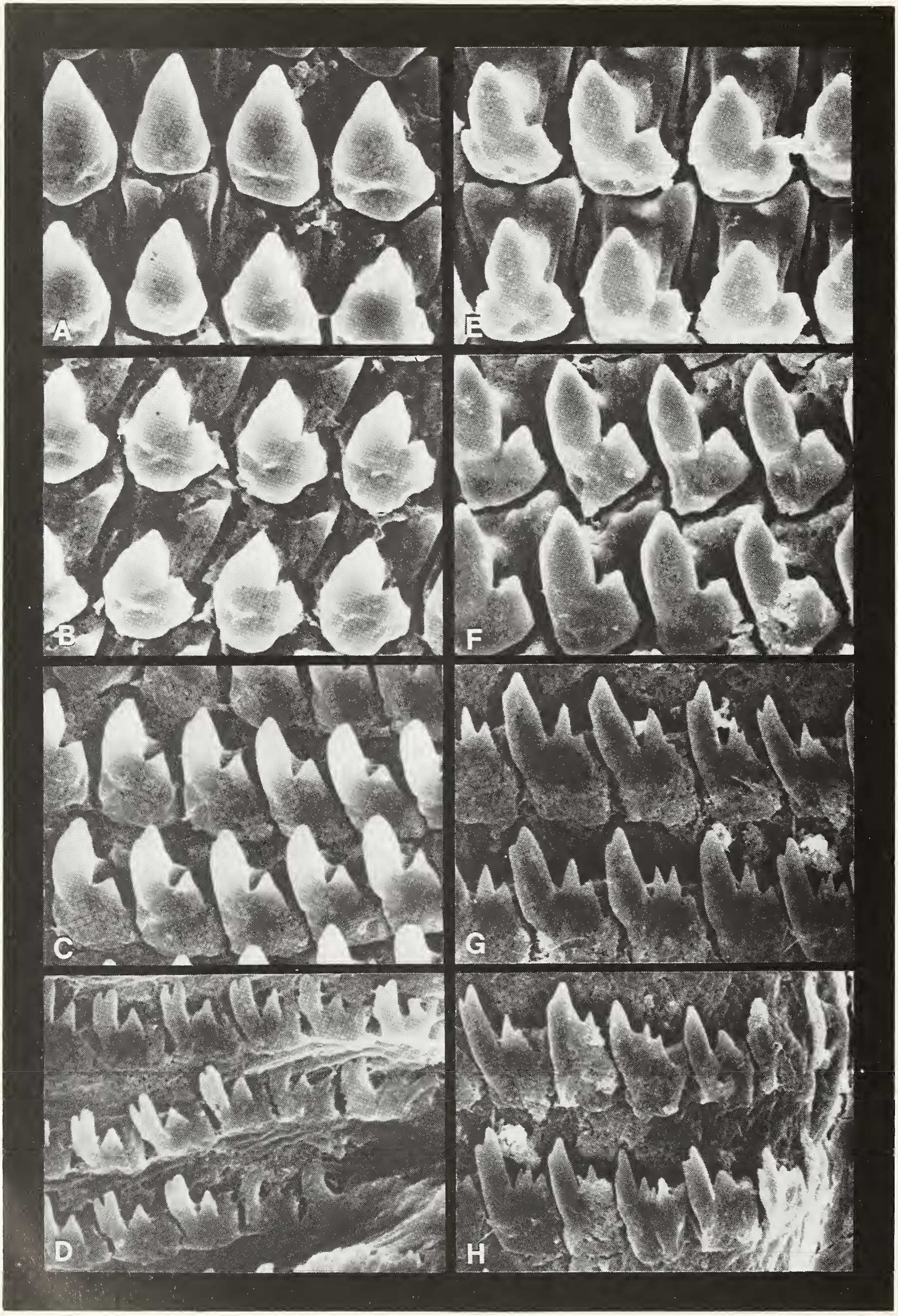

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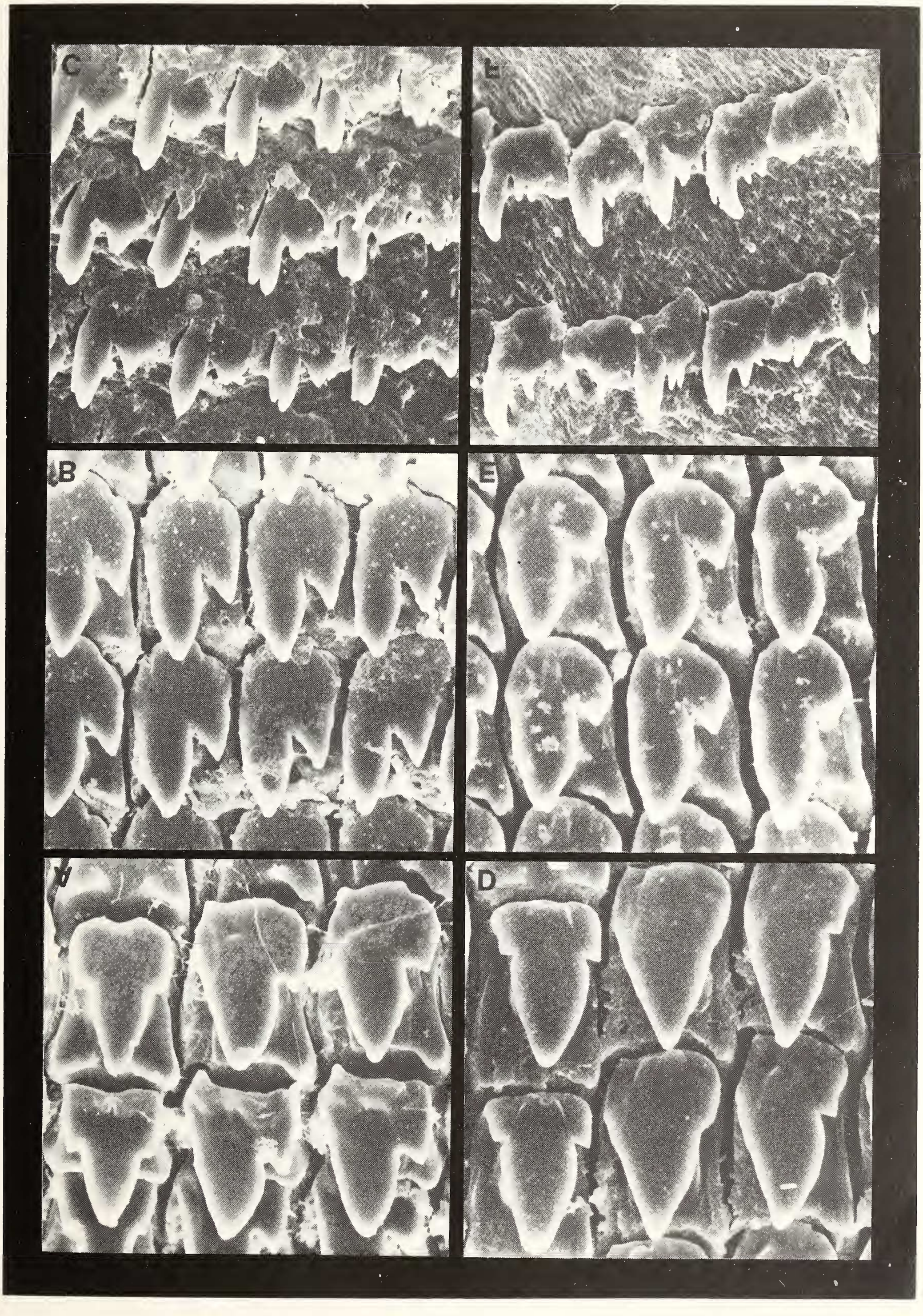

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